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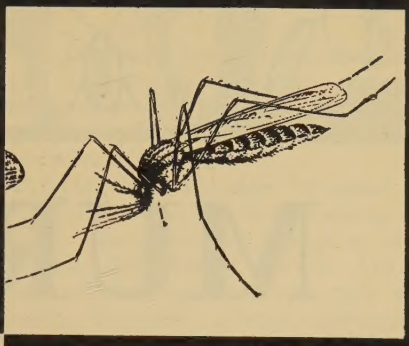

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RETIREMENT OF DR. W. J. HALL, C.M.G., M.C.

The retirement in June of Dr. W. J. Hall, Director of the Commonwealth Institute of Entomology since 1946, will be greatly regretted by the Executive Council and the Staff of the Institute, as well as by entomologists throughout the world, many of whom, especially in the Commonwealth, will remember with gratitude his personal help or advice.

Dr. Hall joined the staff as Assistant Director in 1943, after 23 years in Africa, both in Egypt, where he was Senior Entomologist to the Ministry of Agriculture, and later in Southern Rhodesia, where he had charge of the Citrus Estates and Experimental Station of the British South Africa Company. He thus brought to the service of the Institute not only an authoritative knowledge of the scale insects, but also a long experience overseas of entomological research and its applications, and a thorough understanding of the problems and needs of the man in the field.

His twelve years' tenure of office as Director has covered both the difficult period immediately after the war and the immense expansion of applied entomology that followed, including the developments in the field of insecticides that have virtually transformed the subject. Under his guidance, the Institute has kept abreast of these advances and has been able to fulfil the greatly increased demands made upon it. The circulation of its publications, which is one measure of its health, and which had regained the prewar level by 1946, has since then been doubled. Dr. Hall's foresight has enabled the Institute to acquire as its permanent home the building at 56, Queen's Gate.

In recent years, a very large programme of research has been initiated in the Colonies under the stimulus of the Colonial Development and Welfare Acts, and this has resulted in heavy additional demands on Dr. Hall for advice on entomological matters. He has been a member of the Colonial Research Council since 1950, when he became Chairman of the then Colonial Insecticides Committee, of which he had been a member from its inception in 1947, and he has served on numerous other committees dealing with entomological problems overseas. He has also been closely concerned in the creation of the Colonial Pool of Entomologists and the Colonial Termite Research Unit, both of which are attached to the Institute and link it directly with work in the field, and in another important development, whereby the Institute acts as a centre of entomological information for the Inter-African Phytosanitary Commission.

Dr. Hall has never spared himself in the discharge of his manifold responsibilities, and he has sustained his burdens with a good sense and confidence that have won him the admiration and respect of all who have been associated with him. He takes with him the warmest good wishes of everyone in his retirement.

Dr. Hall is succeeded by Mr. E. O. Pearson, who joined the staff of the Institute as Assistant Director in 1953, after 22 years' experience in Africa. Mr. R. G. Fennah, who has served for 24 years in the West Indies, has been selected for the post of Assistant Director and will take up his appointment shortly.

T. SWAMINATHAN, I.C.S.

Chairman of the Executive Council of the Commonwealth Agricultural Bureaux.

June, 1958.

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Smith (K. M.) & Rivers (C. F.). **Some Viruses affecting Insects of economic Importance.**—*Parasitology* **46** no. 1–2 pp. 235–242, 4 pls., 7 refs. London, 1956.

Success achieved in North America in the control of certain insect pests by the artificial propagation of virus diseases [*R.A.E.*, A **40** 62; **43** 263] stimulated a search for viruses affecting important pests in Britain and elsewhere. In all, 26 viruses, mostly new, affecting 22 species of insects, mostly Lepidoptera, were found, and a list is given showing the insects concerned and the viruses attacking each. Those not occurring in Britain included a granulosis disease of *Natada nararia* (Moore) on tea in Ceylon [**44** 31], a nuclear polyhedrosis of *Kotochalia* (*Açanthopsyche*) *junodi* (Heyl.) on wattle [*Acacia*] in South Africa [**45** 385], and a nuclear polyhedrosis of *Heliothis armigera* (Hb.) on cotton in Uganda.

When a nuclear-polyhedrosis virus obtained from *Vanessa cardui* (L.) in Britain was inoculated into Lepidopterous larvae of 30 species, some of the latter developed a cytoplasmic polyhedral disease, and this was attributed either to the presence of a small amount of cytoplasmic virus in the inoculum or to stimulation of a latent virus already present in the larvae. In further work in 1954, the effect of this virus on pest species for which no virus disease was known was investigated. Almost all of some hundreds of larvae of *Operophtera brumata* (L.) that fed on foliage heavily contaminated with the virus died; mortality began after 10–20 days, and examination under the microscope showed the presence of a cytoplasmic polyhedrosis. Similar results were obtained with *Bupalus piniarius* (L.). In 1955, however, no infection developed in *O. brumata* and very little in *B. piniarius*, but dead larvae of *B. piniarius* infected with a cytoplasmic polyhedrosis indistinguishable from that observed in the laboratory were collected in southern England, and this supports the view that the cytoplasmic disease in the inoculation experiments was induced by the stimulation of a latent virus.

In the summer of 1955, larvae of *Pieris rapae* (L.) and *P. brassicae* (L.) were found to be infected with a very virulent granulosis virus that had probably been introduced in infected immigrants from continental Europe and transmitted to their progeny through the eggs; it is not known whether one or two viruses were involved. Infected larvae of *P. brassicae* ceased feeding, remained motionless and became pallid, especially in the thoracic region; young larvae died after 72 hours and older ones after rather longer. The bodies of the dead larvae, which hang down in the shape of an inverted V and liquefy, were readily consumed by uninfected larvae. Granules were found in the hypodermis and fat-body, and the virus seemed to develop in the nucleus rather than in the cytoplasm. Infection in *P. rapae* followed a similar course, and the virus was probably the one recorded attacking this species in California [**39** 318]. In preliminary cross-transmission experiments, 43 of 100 larvae of *P. brassicae* that fed on foliage contaminated with the virus from *P. rapae* died of a granulosis infection, whereas 17 of 100 control larvae died of granulosis in five days. Since mortality was complete when the virus from *P. brassicae* was used, it is probable that the virus from *P. rapae* acted as a stimulant to a latent one already present. Further evidence of the stimulation of a latent virus by inoculation with a foreign one was obtained during unsuccessful attempts to propagate large quantities of a nuclear-polyhedrosis virus that attacks *Tineola bisselliella* (Humm.) in species having larger larvae, some of which developed a virus disease that could not be transmitted back to *T. bisselliella*.

Hunt (G. M.) & Snyder (T. E.). **An International Termite Exposure Test —Twenty-first Progress Report.**—*Proc. Amer. Wood-Pres. Ass.* **48** pp. 314–327, 8 figs. Baltimore, Md., 1952.

Blew jr. (J. O.) & Johnston (H. R.). **Twenty-second Progress Report.**—*Op. cit.* **52** pp. 272–281, 1 ref. 1956. **Twenty-third and Final Report.**—*Op. cit.* [**53**] prepr. 10 pp., 3 refs. 1957.

These three reports contain the final results of long-term co-operative experiments carried out since 1928–29 in various parts of the world on the effectiveness of chemicals in protecting wooden stakes from termites and decay [*cf. R.A.E.*, A **40** 306, etc.]. It is stated in the last of them that so many of the stakes had been destroyed by 1956 that the work was terminated. The condition of the surviving stakes is recorded, and it is concluded that the preservatives are best compared on the basis of average life values; these are shown in tables for specimens installed at various dates in the Panama Canal Zone, Australia, Hawaii and South Africa. The most effective material was coal tar creosote with an average retention of 13 lb. per cu. ft., which permitted an average life of 21–33 years. Halowax, a chlorinated naphthalene, with somewhat higher retention, was second in effectiveness, giving an average life of 13–21 years. There were occasional exceptions at some of the stations, and water-borne materials, such as nickel arsenate, nickel bichromate, and zinc metarsenite sometimes compared favourably with Halowax. Discrepancies arose, due in some cases to the inclusion of heartwood in a few of the stakes and in others to insufficient penetration, the importance of which was not fully realised in the early years of the work. Superficial applications, such as brushing and brief dipping, were of very limited value.

Martin (Hubert). **Chemical Aspects of Ecology in Relation to Agriculture.**—*Publ. Dep. Agric. Can.* no. 1015, 10 × 6½ ins., 96 pp., many refs. Ottawa, 1957. Price $3.

A laboratory was established in western Ontario in 1950 for the study of the ecological consequences of the widespread and continuous use of chemicals for crop protection. A prerequisite was a survey of the available information on the biologically active chemicals already present in the crop environment, and the author therefore reviews from the literature and correlates data on the significance and nature of the chemical factors concerned in the phenomena of antibiosis and symbiosis as they relate to the main biological components of the crop environment—higher plants, insects, fungi and bacteria. Three of the ten main chapters are concerned with insects. Chemical factors rendering plants attractive or repellent to insects or affecting the development of insects on them are reviewed in the first, abnormal plant growth resulting from insect attack in the second, and the production by insects of substances toxic or attractive to other insects in the third.

Schreier (O.) & Kaltenbach (A.). **Weitere Beobachtungen über das Auftreten von Blattläusen an Rüben in Österreich.** [Further Observations on Aphids infesting Beet in Austria.]—*Pflanzenschutzberichte* **14** pt. 7–9 pp. 119–134, 3 graphs, 3 refs. Vienna, 1955. (With a Summary in English.)

Further observations on the course of infestation by *Aphis* (*Doralis*) *fabae* Scop. and *Myzus* (*Myzodes*) *persicae* (Sulz.) on beet and their importance in the transmission of virus yellows were made in Lower Austria in 1954 [*cf. R.A.E.*, A **44** 318]. Counts of uninfested plants, of plants infested with alates only, with colonies containing immature alates (nymphs with wing pads) and with colonies without immature alates, together with the numbers of nymphs, alates and apterae in sample colonies, and of plants showing

symptoms of virus yellows, were made, usually at weekly intervals, in sections of rows in a field sown on 20th May, and the results are shown on graphs and discussed.

M. persicae was not observed until 14th September, and subsequent infestation by this species was very light. Infestation by *A. fabae* began between 9th and 14th June, alates and small numbers of nymphs being observed on the latter date at the eastern and western edges of the field. Plants harbouring immature alates were observed a week later and reached a maximum number on 28th June, when the percentage of plants infested by *A. fabae* also reached its highest peak (36). The numbers of plants harbouring only alates declined after 6th July, indicating that immigration from the winter food-plants had declined. No immature alates were present on 19th July, but there was a subsequent, though smaller, increase in the first half of August, followed by a decline, and another at the end of September, though these did not result in any increase in the percentage of plants infested. At the end of the season, the population was low and consisted almost entirely of alates, indicating the approach of migration to the winter food-plants. The development of the infestation corresponded with the increase in the size and numbers of the leaves of the plants until the end of July, after which no further increase in size occurred, although the number of leaves continued to rise.

The incidence of virus yellows was very slight; symptoms were first observed on 28th July, and the numbers of infected plants rose gradually until 31st August, when about 3 per cent. were affected. Further counts were rendered difficult by the effects of variable weather on the plants, but probably fewer than 6 per cent. were infected by 12th October. Half the infections were recorded before infestation by *M. persicae* was first observed, and in almost all the other cases *M. persicae* appeared at least six weeks after transmission in the same row had reached its peak. Predators and parasites of the Aphids were observed, but none afforded appreciable control.

Trapping of alates in yellow dishes filled with water [*cf.* **44** 319] yielded *M. persicae* only on 24th July, whereas the numbers of *A. fabae* taken varied with the infestation of the plants, the first being observed on 21st May and the maximum being reached on 27th June.

The pattern of infestation was much the same in other localities in Lower Austria, and there was considerable agreement between the results obtained and those of the previous year [*cf.* **44** 318]. Cold wet weather was partly responsible for the late appearance of *A. fabae* in 1954, and unfavourable conditions in the first half of July were probably the cause of the increased alate population and the coincidence of the peak catches in the dishes with peak infestation of the plants, as compared with 1953.

Schremmer (F.). **Über ein Vorkommen der Tannenstammlaus** *Dreyfusia* (*Adelges*) *piceae* **Ratz. im Wienerwald und ihren Vertilgerkreis.** [An Infestation by *Chermes piceae* in the Wienerwald, and its natural Enemies.]—*Pflanzenschutzberichte* **16** pt. 4–6 pp. 49–69, 15 figs., 21 refs. Vienna, 1956. (With a Summary in English.)

In view of the recent investigations on the natural enemies of *Chermes* (*Dreyfusia*) *piceae* Ratz. on fir [*Abies alba*] in Europe and the introduction of some of them into Canada for control of this Aphid on balsam fir (*Abies balsamea*) [*cf. R.A.E.*, A **45** 379, etc.], the results are given of observations made during an outbreak of *C. piceae* on *A. alba* near Vienna in 1955. The infestation had already declined on one of the five trees selected for observation, but numerous ovipositing sistentes were present on the others on 6th May, when the work began. There were fewer after flowering time, in May–June, and the infestation appeared to have almost disappeared after

cool wet weather in July–August, but numerous first-instar sistentes passed the summer in diapause [*cf.* **21** 283] and these increased in numbers towards the end of August, so that from the end of September to 18th December, when the observations ceased and nymphs and ovipositing females were abundant, the population was almost as high as it had been in the spring. The second-instar nymphs appeared to be the commonest overwintering stage.

A list is given of the predators found; those identified comprised seven species of Coleoptera, five Diptera and four Neuroptera, and they included nearly all those previously recorded [*cf.* **45** 379]. *Scymnus* (*Pullus*) *impexus* Muls. [*cf.* **42** 250] was the most abundant of the six Coccinellids; many larvae were present on 6th May, and they sought pupation sites by 14th May in crevices in the bark protected from rain. When transferred to the laboratory, they pupated from 10th June, the adults emerging from 25th June. Neither adults nor larvae were observed on the trees after July. *Aphidecta obliterata* (L.) [*cf.* **42** 199] was also present on 6th May, when 3–4 adults were observed per trunk and egg-masses were also found. The adults were less numerous by 15th May. The other Coccinellids, *Coccinella conglomerata* L., *Neomysia oblongoguttata* (L.), *Propylaea quindecimguttata* (F.) and *P. quatuordecimpunctata* (L.), were less common. Adults of *Laricobius erichsonii* Rosenh. [*cf.* **42** 280], which were more numerous than any of the foregoing, were already common on 6th May, when 3–5 individuals were found per trunk and pairing was observed. Many older larvae of this Derodontid were seen on 15th May, and the adults had mostly disappeared by 10th June. The larvae pupated in the soil beneath the trees, and adults were present in even greater numbers at the end of July but subsequently returned to the ground to hibernate, the last being observed on 23rd August.

Of the Diptera, *Cremifania nigrocellulata* Czerny was rare, and *Lygocerus piceae* (Ratz.) was reared from a puparium of it [*cf.* **45** 239]. *Leucopis* (*Leucopomyia*) *obscura* Hal. was by far the most abundant of all the predators, larvae occurring throughout the period and being particularly numerous in May and the second half of August. Larvae of *Syrphus arcuatus* (Fall.) [*cf.* **42** 251], which are voracious feeders, occurred on three of the trees and preyed mainly on the *Chermes* adults. Ten collected on 15th May pupated on 17th–19th May, but only three adults emerged, on 29th–30th May, the remainder of the puparia giving rise to the Ichneumonid parasite, *Diplazon ornatus* (Grav.), on 6th June. Larvae of another Syrphid, *Cnemodon dreyfusiae* Delucchi & Pschorn-Walcher, were observed on 25th September, and those of the Cecidomyiid, *Aphidoletes thompsoni* Möhn, which are known to be most numerous in autumn and to play an important part in the control of *Chermes piceae*, were present on 23rd August, occurred in greater numbers on 25th September, and were absent in December.

Of the Neuroptera, larvae of *Chrysopa ventralis* Curt. and *C. flavifrons* Brauer were present at the rate of 5–6 per trunk from the beginning of May to mid-June. Larvae collected on 15th May spun cocoons on 22nd–25th May, and the adults of the two species emerged on 21st and 18th June, while others collected on 10th June yielded adults of the two species on 2nd and 8th–12th July, respectively. Pupation frequently occurred in the ground litter as well as on the trunks. Cocoons of a Hemerobiid were found in the soil, and Hemerobiid larvae were as abundant as *Chrysopa* larvae in May; they comprised *Wesmaelius* (*Boriomyia*) *quadrifasciatus* (Reut.) and *Drepanepteryx phalaenoides* (L.). Larvae of an unidentified Trombidiid were observed feeding on ovipositing females of *Chermes piceae* on 23rd August, and adults were found among the needles at the base of the trunks in November; Trombidiids were not previously known to prey on this species.

Leuchs (F.). **Aus *Scolytus rugulosus* Ratz. erzogene Parasiten.** [Parasites reared from *S. rugulosus*.]—*Z. PflKrankh.* **62** pt. 8–9 pp. 550–551, 1 fig., 2 refs. Ludwigsburg, 1955.

When twigs from a pear tree, growing in the Düsseldorf region, that had become infested by *Scolytus rugulosus* (Ratz.) as a consequence of frost damage in early 1954 were brought into the laboratory in January 1955, Hymenopterous parasites identified as *Rhaphitelus maculatus* Wlk., *Cheiropachus colon* (L.) and *Entedon leucogramma* Ratz. emerged from them between February and May, in addition to adults of the Scolytid. The first represented 75 per cent. of the parasites, and on the assumption that each had developed on one larva, the total percentage parasitism was 43. The author is aware of only one other detailed reference to parasites of *S. rugulosus* in Europe [*R.A.E.*, A **9** 402].

Langenbuch (R.). **Untersuchungen über die Ursache der unterschiedlichen DDT-Empfindlichkeit der L_3- und L_4-Larven des Kartoffelkäfers (*Leptinotarsa decemlineata* Say).** [Investigations on the differing Susceptibility to DDT of third- and fourth-instar Larvae of *L. decemlineata*.]—*Z. PflKrankh.* **62** pt. 8–9 pp. 564–572, 2 graphs, 21 refs. Ludwigsburg, 1955. (With a Summary in English.)

When third- and fourth-instar larvae of *Leptinotarsa decemlineata* (Say) were allowed to feed on leaf sandwiches containing DDT, so that contact action was excluded, or exposed after starvation to a DDT solution on filter paper in petri dishes, the older larvae proved much less susceptible to the poison than the younger ones. This is attributed to their greater lipid content [*cf. R.A.E.*, A **42** 369], the total content of lipoids being 2·34 times as great, the lipoid level of the haemolymph 37 per cent. higher and the number of haemocytes in it 3·5 times as high in the fourth- as in the third-instar individuals.

Schuch (K.). **Einiges über die Erdbeerblattlaus *Pentatrichopus fragaefolii* Cock.** [A Note on the Strawberry Aphid, *Capitophorus fragaefolii*.]—*Z. PflKrankh.* **62** pt. 8–9 pp. 581–588, 5 figs., 6 refs. Ludwigsburg, 1955.

Capitophorus (*Pentatrichopus*) *fragaefolii* (Ckll.), which is of importance as a vector of strawberry viruses in the United States and England and also occurs in France and Holland, was found to be common on strawberry in parts of western Germany, particularly at Bühl in Baden. A map is given showing its distribution there, and its bionomics are reviewed from the literature. When infested strawberry leaves from Bühl were brought to the laboratory and the Aphids transferred in batches of ten to healthy seedlings of *Fragaria vesca* without an intervening period of starvation and allowed to feed for three days, the latter developed conspicuous symptoms of virus disease in a few weeks. The virus was not identified.

Moericke (V.). **Über das Verhalten phytophager Insekten während des Befallsflugs unter dem Einfluss von weissen Flächen.** [The Influence of White Surfaces on the Behaviour of phytophagous Insects during Infestation Flights.]—*Z. PflKrankh.* **62** pt. 8–9 pp. 588–593, 2 figs., 1 ref. Ludwigsburg, 1955.

Many phytophagous insects flying over the soil in search of food-plants can be induced to settle on yellow or green surfaces [*cf. R.A.E.*, A **41** 8],

but the effectiveness of these is reduced by the proximity of white ones. In order to ascertain whether the white colour repels the insects or merely neutralises the effect of the yellow, experiments were carried out near Bonn in which two suction traps were sunk into the soil with their mouths at ground level and one of them was surrounded with a white cloth. Two yellow trap dishes were also set out, one on the soil and the other on a white cloth. More than three times as many insects were taken in the suction trap without the cloth as in the one with it, and the difference was particularly great for *Aleurodes proletella* (L.) (*A. brassicae* (Wlk.)) and *Myzus* (*Myzodes*) *persicae* (Sulz.). A similar result was obtained with the dishes. The catches were usually less in these than in the suction traps, but more of *M. persicae* were taken in the former than the latter. It is concluded that white surfaces are avoided by most insects in search of food-plants, and that this is possibly the result of a negative reaction to white light or surfaces reflecting it, such insects commonly orientating themselves with reference to the sky.

Dosse (G.). **Aus der Biologie der Raubmilbe** *Typhlodromus cucumeris* **Oud. (Acar., Phytoseiidae).** [On the Bionomics of the predacious Mite, *T. cucumeris*.]—*Z. PflKrankh.* **62** pt. 8–9 pp. 593–598, 5 refs. Ludwigsburg, 1955.

Typhlodromus cucumeris Oudm. is a predacious mite that occurs on apple in Germany in association with Tetranychids. Laboratory observations on its bionomics showed that its development was completed in an average of 6·7 days at constant temperatures of 25–26°C. [77–78·8°F.] and in 23·5 days at 15–16°C. [59–60·8°F.]. Both sexes passed through a larval and two nymphal stages. The fertilised females laid 36 eggs each at the higher temperature, at the rate of 1·4 per day. Fewer eggs were laid and mortality in the immature stages was high at the lower temperature. Fertilised and unfertilised females lived for six weeks or more and not more than 14 days, respectively, and the latter did not oviposit. The larvae did not feed, but the older stages fed on *Tetranychus telarius* (L.) (*urticae* Koch), *Panonychus* (*Metatetranychus*) *ulmi* (Koch) and *Czenspinskia lordi* Nesbitt and occasionally on *Bryobia praetiosa* Koch, attacking both eggs and mobile stages.

Müller (H. J.). **Zur Frage der** *Bruchus*-**Resistenz von Ackerbohnen** (*Vicia faba* **L.). Vorläufige Mitteilung.** [The Problem of the Resistance of Field Beans (*V. faba*) to *Bruchus*. Preliminary Communication.]—*Z. PflKrankh.* **62** pt. 8–9 pp. 598–602, 1 graph, 3 refs. Ludwigsburg, 1955.

It has long been known that early-ripening large-seeded varieties of field beans (*Vicia faba*) are more heavily infested by *Bruchus rufimanus* Boh. in Germany than late-ripening small-seeded ones [*cf. R.A.E.*, A **21** 528], and an account is given of observations in the field in 1951 showing that this is due to a preference of the females for oviposition on the former, though both were grown experimentally at about the same time. The property of the pods responsible is not known.

Ehlers (M.). **Saatgutbehandlung gegen die Möhrenfliege.** [Seed Treatments against the Carrot Fly.]—*Z. PflKrankh.* **62** pt. 8–9 pp. 617–619, 6 refs. Ludwigsburg, 1955.

In experiments in Germany on the effectiveness of seed treatments in protecting carrots from the carrot fly [*Psila rosae* (F.)], almost complete

protection was given by wetting the seeds with a slurry made from a powder containing 80 per cent. lindane [almost pure γ BHC] at the rate of 10–20 per cent. insecticide by weight of seed, and similar treatment with dieldrin was almost as good; DDT was largely ineffective and greatly reduced germination. Dry treatment with γ BHC powder was less effective, but very good results were given in further tests by treatment of the soil, just before sowing, with 1·5 per cent. γ BHC or 2·5 per cent. aldrin at 90 lb. per acre.

Ehrenhardt (H.). **Zur Bekämpfung des Drittengerlings von** *Melolontha melolontha* **mit chemischen Mitteln.** [On the chemical Control of the third-instar Larvae of *M. melolontha*.]—*NachrBl. dtsch. PflSchDienst* **9** no. 1 pp. 1–6, 5 graphs, 5 refs. Stuttgart, 1957.

Control of the third-instar larvae of *Melolontha melolontha* (L.) is generally considered impracticable owing to their short feeding period and the consequently large amounts of insecticide required. In tests in the Palatinate, where development of this cockchafer lasts three years, economic control could not be achieved by harrowing γ BHC into the soil during the spring in the year of pupation, but promising results were later obtained against the second-instar larvae by ploughing insecticides into the soil late in the autumn before the chief year of feeding, and further tests against third-instar larvae were therefore carried out. Two localities were chosen in which third-instar larvae were present in the autumn of 1954 at the rate of about 8 per sq. yard. In one, a preparation containing 15 per cent. γ BHC was applied to the soil at 2·7, 4 or 5·4 lb. toxicant per acre and one containing 15 per cent. aldrin at the two higher rates immediately before ploughing in November 1954 or before harrowing, which was carried out twice, in the spring prior to sowing. The same treatments were also carried out in the other, supplemented by one in which the insecticides were ploughed into the soil at the same rates in March, and γ BHC and aldrin were applied throughout at the additional rates of 1·35 and 2·7 lb. per acre, respectively. Beet was sown in both localities in April.

The population in untreated plots did not decrease during the winter, but fell by half or more during the vegetative period of 1955, largely as a result of soil cultivation. Feeding was restricted by cool wet weather in the early part of the season, but the infestation was sufficient to have caused considerable injury under drier conditions. Pupation began about mid-July, and the proportion of larvae to pupae had declined to about 1:5 a week later. The results of the treatments were estimated after hoeing on 29th June and again at harvest in October–November. On the first date, plant losses were estimated, and percentages of protection calculated according to Abbott's formula [*cf. R.A.E.*, A **13** 331]. These were about 40 for the lowest and 60–75 for the higher rates of γ BHC and about 50–60 for aldrin applied in the autumn, about 60–75 for both insecticides ploughed under in spring and about 10–50 and 10–40 for γ BHC and aldrin, respectively, harrowed into the soil in spring. At harvest, observations on plant growth and damage were supplemented by counts of newly emerged adults in the soil. The percentage reductions in the numbers of plants that had died were then about 15 and 30–45 for γ BHC at the lowest and the higher rates, respectively, and about 25–35 for aldrin for the autumn treatments, about 15–30 for spring ploughing and 5–25 for spring harrowing. The percentage reduction in the adult population was about 85–100 for all the autumn treatments except γ BHC at the lowest rate (for which it was 60), 75–85 for spring ploughing and 0–75 for spring harrowing, the results for the last being very much better in one locality than in the other.

It is concluded that the time of application is less important than the method of incorporation into the soil; harrowing did not distribute the insecticides sufficiently deeply and γ BHC at the highest concentration caused some injury to the plants under these conditions, but ploughing in either season gave satisfactory results. The required quantities of active ingredient are about 1·8–2·7 lb. γ BHC and 2·7–3·6 lb. aldrin per acre for ploughing and over 4 lb. per acre of either material for harrowing.

Baggiolini (M.). **Observations sur l'activité de la tordeuse de la pelure (*Capua reticulana* Hb. = *Adoxophyes orana* F.R.) en Suisse romande.** —*Rev. rom. Agric.* **13** no. 6 pp. 44–46, 4 figs., 6 refs. Lausanne, 1957.

Adoxophyes orana (Fisch. v. Roesl.) (*Capua reticulana* (Hb.)) continued to be injurious on fruit trees in Valais and near Lake Geneva in 1954–56, in the last of which years it damaged 41 per cent. of pears and 65 per cent. of apples at one locality. Its bionomics are described [*cf. R.A.E.*, A **43** 378], and general recommendations made for control.

d'Aguilar (J.), Bessard (A.) & Parisot (J.). **Pullulation d'une noctuelle (*Oria musculosa* Hb.) dans les cultures d'orge de la Champagne Berrichonne.**—*C. R. Acad. Agric. Fr.* **43** no. 6 pp. 343–346, 5 refs. Paris, 1957.

Oria musculosa (Hb.), which had not so far proved injurious in France, caused much damage to barley in the department of Indre in 1954–56, in the last of which years losses averaged about 40 per cent. This Noctuid has one generation a year and overwinters in the egg stage. The larvae, which hatched in late April in 1956, enter the stems, destroying the terminal buds, and migrate from one to another as they develop. Pupation occurs in the soil, beginning in late June in 1956, and the adults emerge about a fortnight later. Oviposition begins in the first fortnight of July, the eggs being laid mostly at the level of the second node, beneath the sheath, and embryonic development is completed before winter, which is passed in the stubble. Damage is most severe on barley following wheat, which may indicate a preference for oviposition on wheat, and adults were observed flying from barley towards neighbouring wheat, on which adults and eggs were more numerous than on the barley. The larvae were parasitised by *Barylypa rufa* (Hlmgr.) and *Conomorium eremita* (Forst.). Infestation has apparently been favoured by an extension of cereal cultivation in the area; burning the stubble is recommended for control.

Cayrol (R.). **Observations sur la pullulation de deux nouvelles espèces de Noctuidae nuisibles aux cultures de betteraves.**—*C. R. Acad. Agric. Fr.* **43** no. 6 pp. 346–349. Paris, 1957.

Euxoa nigricans (L.) and *E. tritici* var. *aquilina* (Schiff.) were unusually injurious to beet near Orleans in 1954–56, when larvae migrated to the crop from neighbouring weeds in late April and May and destroyed the young plants in a few days. *E. nigricans* constituted 75 per cent. of the population in 1955 and 92 per cent. of it in 1956. Notes on the habits of these cutworms are given, followed by an account of experiments on control. From the results of these, barrier sprays of 0·2 per cent. dieldrin, to protect a

field, and a bait consisting of equal parts by weight of bran and an emulsion containing 0·3 per cent. endrin or dieldrin, to control larvae already present, are recommended.

Couturier (A.) & Robert (P.). **Signification au point de vue agricole de l'orientation astronomique du hanneton commun.**—*C. R. Acad. Agric. Fr.* **43** no. 6 pp. 350–352; 6 refs. Paris, 1957.

From further observations in France on flight orientation in *Melolontha melolontha* (L.) [*cf. R.A.E.*, A **45** 117, etc.], it is concluded that this is of the type known as astronomic, in which a sense of time of day and a knowledge of the apparent movement of the sun combine to cause flight to follow a given direction or its reverse. The line of flight initially followed by the newly emerged female in moving from the soil to trees or forest edges for maturation feeding thus determines the direction of the oviposition flight, which is in the reverse direction, and of subsequent feeding and oviposition flights. This explains the apparently random movements of individuals in the same area, some flying in one direction and some in another. There may be some subsidiary movement from one feeding site to another, the reason for which is not understood.

Frézal (P.). **Sur la présence en Algérie de la tristeza et de la xyloporose des** *Citrus*.—*C. R. Acad. Agric. Fr.* **43** no. 6 pp. 353–356. Paris, 1957.

Tristeza disease was observed in 1955 on an acid variety of lemon in Algeria. The affected trees were destroyed, and it is thought that the disease was thereby eradicated. Of the three Aphids known to transmit the virus [*cf. R.A.E.*, A **44** 330–331], only *Aphis gossypii* Glov. occurs in Algeria; it is common on *Citrus* there.

Pussard (R.). **La culture des lavandes gravement menacée par la cécidomyie,** *Thomasiniana lavandulae* **Barnes.**—*C. R. Acad. Agric. Fr.* **43** no. 6 pp. 333–336, 6 refs. Paris, 1957. **Éthologie des imagos de** *Thomasiniana lavandulae*, **Barnes (Dipt. Cecidomyiidae).**—*T. c.* no. 9 pp. 502–506, 3 refs.

In the first of these papers, the author states that *Thomasiniana lavandulae* Barnes [*cf. R.A.E.*, A **42** 184] causes severe damage to cultivated and wild lavender (*Lavandula vera* (*angustifolia*) and hybrids of this and *L. spica* (*latifolia*)) throughout the mountainous districts of Provence. The larvae develop beneath the bark, causing necrosis and the drying-up of the branches. This is the principal cause of the loss of productivity of plantations and natural growths that has been observed in recent years.

In the second paper, he describes the habits of the adults of this Cecidomyiid. The larvae pupate in cocoons in the soil beneath the plants in mid-October, and some individuals complete pupal development as early as the second half of December. The fully developed pupae leave the cocoons, generally after rain or when snow has melted, and move to the surface of the soil by a series of spiral movements, which may be continued for some time on the surface. The adults emerge after a short period of rest; a few emerge during the upward movement in the soil, but these die without reaching the surface. Near Digne, emergence occurred from 24th January until about 8th April in 1957, during sunny weather following rain. The adults shelter usually in dark sites on the plants and fly only short distances, though swarming flights occur in and about the plants in sunshine. Wind

had little effect on flight activity. The adults pair soon after emergence and live for not more than 2–5 days, females slightly longer than males. The females laid 50–100 eggs each, on the plants.

Perttunen (V.). **Reactions of two Bark Beetle Species, *Hylurgops palliatus* Gyll. and *Hylastes ater* Payk. (Col., Scolytidae) to the Terpene α-Pinene.**—*Ann. ent. fenn.* **23** no. 2 pp. 101–110, 12 figs., 18 refs. Helsinki, 1957.

The following is almost entirely the author's summary. The reactions of adults of *Hylastes* (*Hylurgops*) *palliatus* (Gylh.) and *H. ater* (Payk.), collected from pine in England, to α-pinene were investigated by exposing the insects to two concentrations, 120 and 12 cu. mm. per covered dish 14·5 cm. in diameter and about 10 mm. high, in a diffusion gradient with activated charcoal as absorbent. *H. palliatus* was strongly repelled by the higher and slightly repelled by the lower concentration of pinene. *H. ater* was slightly repelled by the higher concentration and slightly but significantly attracted by the lower one. Klinotactic reaction mechanisms were observed on the boundary between the area containing the pinene and the scentless area. The reactions of these two species to α-pinene are in keeping with the quality of the pine rind from which they were collected; *H. palliatus* was found in rind that was already brown in colour and had no resinous smell, and *H. ater* in recently cut logs with a white rind under the bark and a definite smell of resin. The rôle played by pinene and other terpenes in bark-beetle orientation is briefly discussed.

Hassall (K. A.). **Some Factors affecting the physical Toxicity of Fumigants.**—*J. Sci. Fd Agric.* **8** no. 7 pp. 415–522, 2 graphs, 22 refs. London, 1957.

The following is virtually the author's summary. The fumigant toxicities to *Calandra granaria* (L.) of 39 alkyl chlorides, bromides and thiocyanates have been estimated with considerable accuracy [*cf. R.A.E.*, A **44** 148]. The difference between toxicities of isomers on the thermodynamic scale [*cf.* **37** 412] is small, except near the cut-off point, or when instability or chemical reactivity is evident. Near the cut-off point, the characteristic sudden rise in the ratio p_t/p_s (toxic vapour pressure/saturation vapour pressure) is more marked the lower the vapour pressure of the isomers, so that a secondary compound may be toxic when the normal one is non-toxic. Vapour pressure may also be a limiting factor for a whole series when the saturation vapour pressures of even the lower homologues are small. For chlorides and bromides, p_t/p_s values change slowly with carbon content below the cut-off member, but for unit saturation vapour pressure the bromides are the more toxic. When a molecular volume correction factor, V, is introduced, the points for chlorides and bromides form a single line, the slope of which approximates to unity. The equation, $\log (p_t/V) = \log p_s + k'$, gave better results than $\log p_t = b \log p_s + k$, when it was applied to various published data, and experimental evidence was therefore found justifying a mainly theoretically derived equation of McGowan.

Experiments using different times of exposure, and with death as the criterion of toxicity, indicated no difference of behaviour between physical and chemical poisons. Doubling the exposure time approximately halved the LD50 and hence the p_t/p_s value. This provides further evidence that the arbitrary physical/chemical barrier of $p_t/p_s = 0{\cdot}05$ has little practical significance.

Pingale (S. V.), Kadkol (S. B.), Narayana Rao (M.), Swaminathan (M.) & Subrahmanyan (V.). **Effect of Insect Infestation on stored Grain. II. Studies on Husked, Hand-pounded and Milled Raw Rice, and Parboiled Milled Rice.**—*J. Sci. Fd Agric.* **8** no. 9 pp. 512–516, 8 refs. London, 1957.

The following is virtually the authors' summary of this part of a series recording experiments carried out in India [*cf. R.A.E.*, A **42** 244]. Husked, hand-pounded, milled raw rice and parboiled milled rice obtained from the same strain of paddy were infested by *Calandra oryzae* (L.) for a period of eight months and the changes brought about in the different samples as a result of infestation studied. The results show that husked rice was infested to a greater extent than the other samples and developed an unhealthy appearance within two months of infestation. Parboiled and raw, milled samples of rice were found to be least susceptible to infestation. Infestation of the rice grain increased the loss of starch in the gruel during cooking, the loss being maximum in the case of husked rice. An appreciable increase in the acidity of fat and a decrease in the thiamine content due to insect damage were observed. No significant difference was noted in the other constituents of the grain, such as total nitrogen and soluble nitrogen. Some correlation was observed between the weight/volume ratio of uncleaned grain and the proportion of dust, loss in total weight, loss in thiamine and insect population.

Kiritani (K.). **On the local Distribution of two allied Species of the Rice Weevil, *Calandra oryzae* and *C. sasakii*.**—*Jap. J. appl. Zool.* **21** no. 2 pp. 74–77, 2 figs., 8 refs. Tokyo, 1956.

A small form of *Calandra oryzae* (L.) occurring in stored grain in Japan was described as *C. oryzae* var. *minor* by Sasaki in 1899 and as *C. sasakii* by Takahashi in 1918 [*R.A.E.*, A **16** 360]. Yasue was informed in 1952 by G. A. K. Marshall, to whom he had submitted specimens from Japan, that the small form was not more than varietally distinct from the large one and that the name *C. oryzae* var. *minor* might be used for it. Small and large forms occurring in other parts of the world have been considered by most workers as no more than strains, though Birch referred to them as sibling species in Australia [**43** 122]. The author treats the small forms recorded in different countries as one, but, in view of the results of crossing experiments [**33** 362; **34** 21–22; **45** 415], as not conspecific with *C. oryzae*, and uses the name *C. sasakii* for them.

A survey of the local distribution of the forms in the Kinki district of Japan was carried out from early summer to late autumn in 1953, the weevils being collected from rice, wheat and barley stored on farms and other premises at 14 localities differing in climate, altitude and topography. When both were present in numbers, frequency histograms showing the size distribution of the lengths of the elytron and the pronotum could be separated into two different parts, but when the small form was rare, as was usually the case, they were separated by means of the sculpture on the pronotum. The small form occurred always in association with the large one, which was invariably the more abundant. The large one was present in all the localities examined, which ranged in height from sea-level to about 1,400 ft. and in annual average temperature from 12 to 16°C. [53·6 to 60·8°F.], whereas the small one was confined to urban and suburban areas with an altitude of 300 ft. or less and an annual average temperature above 15°C. [59°F.]. It is noted that in Nepal [*cf.* **45** 415] the small form was found at high altitude and the large one at low altitude.

In Australia and England, the large form is often found associated with maize and the small one with wheat, but both were found in all three cereals investigated in Japan. The small strain does not fly in Japan, though it does so in Nepal [**45** 415], and it is therefore restricted to storage premises, whereas the large one is able to fly and infests grain in the field as well as in store. This has a considerable bearing on distribution.

Hammond (P. S.). **Capsid Control on mature Cocoa.**—*New Gold Cst Fmr* **1** no. 3 pp. 109–115, 1 fig. [Accra] 1957.

Experiments in Ghana on the control of Mirids [*Sahlbergella singularis* Hagl. and *Distantiella theobroma* (Dist.)] on mature cacao by means of mist sprays applied by knapsack equipment were begun in June–July 1954. An emulsion concentrate containing 25 per cent. DDT was applied at 6 pints or 1 gal. in 10 gals. or at 1 gal. in 5 gals. spray per acre, and another (Gammalin 20) containing 20 per cent. γ BHC was applied at 1·5 pints (6 oz. γ BHC) in 10 gals. or 2 pints (8 oz. γ BHC) in 5 or 10 gals. spray per acre. Treatments were made monthly. In subsidiary tests, a high-volume spray of DDT applied to the pods only, a dust affording 1 or 1·5 oz. γ BHC per acre applied fortnightly, and a DDT mist spray applied to pockets of Mirid damage only, were compared with the foregoing. The results were assessed monthly by a scale evaluating both damage caused by the Mirids and regeneration of foliage, and the results of the main treatments were promising from the outset. Within a month or so, Mirids were absent from the sprayed areas, new pods were clean and smooth, and regeneration of foliage was rapid, even on trees having no leaves remaining at the first application. Mirid populations are invariably high and damage most intense in December–January, and it became evident by November that the DDT sprays were failing to maintain control, though the γ BHC sprays and dusts were still effective. The γ BHC treatment also afforded control over a belt some 30–50 paces wide round the treated area, owing to a vapour effect of the insecticide, the existence of which was later confirmed in the laboratory [*cf. R.A.E.*, A **45** 311]. At the end of the first year, the results showed that the γ BHC sprays and dusts all gave complete control, with no adverse effects on yield due to treatment, whereas the DDT mist sprays were markedly less effective and the pod spray gave no control. There was no indication that the mist sprays had failed to reach the top of the canopy.

In 1955–56, further plots and some of the plots originally sprayed with γ BHC were treated with the mist spray at 0·5, 1, 2, 4 and 6 oz. γ BHC per acre applied monthly, 2 oz. per acre applied at intervals of six weeks, and 1, 2 and 4 oz. at intervals of eight weeks, all in 5 gals. spray per acre, and BHC dusts were further tested. In February 1956, after the period of peak damage, the results showed that the dusts were less effective than the sprays. The latter maintained good control at rates as low as 1 oz. γ BHC per acre on the plots sprayed from mid-1954 and gave consistent though somewhat less conclusive control at 4 and 6 oz. on the new plots, but were not completely effective at 1–2 oz., though they gave some control at these rates even when applied at the eight-week interval; this interval appeared in general to be too long and one of four weeks more reliable. Trees left untreated from March 1955 after previous treatment with the γ BHC mist spray showed renewed damage after 42–316 days.

As a result of the two years' work, a standard treatment for mature cacao was recommended, comprising mist sprays of 1 pint of the γ BHC concentrate (4 oz. γ BHC) in 5 gals. spray per acre applied twice at an interval of a month, followed by treatment of localised areas as new damage is observed.

The time and degree of reinfestation vary with the size of the sprayed

area, and they were investigated in 1955–56 on units of 60–225 acres. Two applications of γ BHC at 6 oz. per acre were followed by monthly treatment at the same rate of a strip 50 yards wide round the perimeter. The plots were inspected monthly, and any trees showing damage were resprayed. All the units were kept virtually free from damage until the time of writing, and not more than one tree per acre became reinfested. Similar observations in 1956–57 showed that a 5-acre sprayed plot surrounded by heavily infested unsprayed cacao requires retreatment fairly regularly and that reinfestation is governed largely by the size of the sprayed area and the degree of the surrounding infestation. Complete re-establishment of the canopy appeared to delay reinfestation.

Yield records were kept in the various years and showed increases due to spraying in all cases. The increases were greatest when damage had previously reduced yields to negligible amounts and in extreme cases were over 200 per cent. in the second year of treatment and over 600 per cent. in the third. Even where the yield had been least depressed, increases of 4 and 43 per cent. in the second and third years were observed.

In view of the favourable results given by the γ BHC mist sprays, a "saturation spraying scheme" was begun in March 1956, in which the standard recommended treatment was to be applied over an area of about 150,000 acres including some 100,000 acres of cacao varying in age from 0·7 to over 30 years. A technique for the operation of spray gangs using six machines each was developed, and it was found that one gang could spray 30 acres or more per day, at a total cost of 25s. per acre. The two applications were expected to be completed by the end of 1957. A Mature Cocoa Extension Spraying Scheme was also set up with the object of spraying free of charge some 700,000 acres of severely damaged cacao on farms. Some 24,000 acres had received the two applications by the end of 1956, and the task was expected to be finished by the end of June 1958. Retreatment by farmers to maintain their trees free from infestation is urged.

Annual Report of the West African Cocoa Research Institute 1956–57.— 90 [+3] pp., col. frontis., 1 map. Tafo, 1958.

This report on investigations on cacao in Ghana and Nigeria [*cf. R.A.E.*, A **45** 308] in 1956–57 includes sections dealing with work on the swollen-shoot virus, mealybugs and Mirids (Capsids).

Work in Ghana on the host range of strains of the swollen-shoot virus is described by W. T. Dale & A. Attafuah, and insect transmission studies by Dale. In the latter, further attempts to transmit the New Juaben strain of the virus by means of nymphs or young adults of *Pseudococcus njalensis* Laing allowed to feed for an hour or less on young infected plants proved unsuccessful, and there was no reduction in infectivity when the mealybugs were allowed to feed for 1, 2 or 3 days on the infected source plant. Nymphs and young adults proved about equal in vector efficiency, and no evidence could be obtained of transmission from infective parents to their progeny. Like *P. njalensis*, *Planococcus citri* (Risso) transmits virus isolates from baobab (*Adansonia digitata*), but *Ferrisiana virgata* (Ckll.) has so far failed to do so. *F. virgata* experimentally transmitted two isolates from the Western Province and two from Ashanti, and *Pseudococcus* sp. near *gahani* Gr. transmitted one from the Western Province. The New Juaben and Kpeve strains have been occasionally transmitted in the past by *Dysmicoccus brevipes* (Ckll.) from pineapple, though these insects could not be permanently established on cacao. More recently, examples from groundnuts, which probably represent a distinct strain of *D. brevipes*, failed to transmit the New Juaben strain. *P. njalensis* transmitted isolates from the Eastern

Province and Togoland, but not one from Nigeria. Nymphs of this mealybug successfully transmitted the virus from both completely green and fully ripe pods from infected trees. *P. njalensis* was also used in investigations on the classification and comparison of isolates, recorded by Attafuah & Dale, and on resistance and tolerance to the New Juaben and Kpeve strains by Dale.

In studies in connection with the mealybugs, D. J. Taylor reports on experiments to assess the effect of dieldrin sprays on the ants that protect the mealybugs by means of carton shelters. Three areas were selected, a belt 30 yards wide was demarcated round each disease outbreak in them, and an emulsion spray of 1 per cent. dieldrin was liberally applied by motorised mist-sprayer at the rate of 10 gals. per acre to the trunks of all the trees included, whether cacao or not, up to a height of 8–10 ft. All trees were surveyed weekly for ant activity, and it was found that this was completely disrupted by the spray soon after application, the vast majority of ant colonies becoming moribund. Reinfestation began after 4–8 weeks but proceeded slowly. Crematogasterines and Pheidolines, which nest on or in the trunks and are the principal attendant ants, required more than 28–30 weeks for effective re-establishment. *Oecophylla longinoda* (Latr.) and *Macromischoides aculeatus* (Mayr), which are leaf-nesting species and inimical to the mealybug-tending ants, became re-established after about 16 weeks. Tests to assess the effect of this treatment on the mealybugs are described by P. F. Entwistle. In the first, weekly counts made to hand height showed that infestation by *Pseudococcus njalensis* had disappeared six weeks after the application of the dieldrin spray and showed very little increase at 16 weeks. Other species were reduced less sharply, and populations in unsprayed areas remained high. In another, similar fortnightly counts of *P. njalensis* showed a 98·5 per cent. reduction in 12 weeks, with no discernible effect on other species, and in a third, in which the trees were felled and mealybug counts made along all their length, the third fortnightly count after spraying showed a 90 per cent. reduction in *P. njalensis*. Adults of this species were retained for estimates of parasitism, and it was found that this increased rapidly from 1–2 per cent. before treatment to a peak of 18–20 per cent. as the host population fell and then decreased as the mealybugs became really scarce. Although the parasites doubtless afforded some control as ant protection decreased, most of the mealybugs were killed by fungus infection, which probably began in the unconsumed honeydew.

Work on Mirids [*Sahlbergella singularis* Hagl. and *Distantiella theobroma* (Dist.)] comprised investigation on control by insecticides on mature cacao and population studies, reported by Taylor and Entwistle, respectively. In the former, mist sprays prepared from emulsion concentrates were applied at 5 gals. per acre, and the plots were sprayed twice at an interval of eight weeks, beginning in August 1956, with endrin, heptachlor, γ BHC, dieldrin or aldrin at 2 oz. per acre or twice at a monthly interval with aldrin at 4 oz. Observations were continued until March 1957, so as to include the period of highest populations and greatest damage. Endrin gave the best results, trees sprayed with it showing far less damage than the others and satisfactory regeneration of damaged foliage. The effect was well maintained for 24 weeks, and except for heptachlor, the other materials also gave good control, with little difference between them. In the population studies, it is stated that the investigation of the possibilities of estimating the population by means of egg counts [*cf.* **45** 310] was discontinued in December 1956. Significant correlations were obtained between post-hatching populations and counts of unhatched eggs in the previous sampling period, and transformation of the data to weighted fortnightly running means (one fortnight being the sampling interval) revealed a significant correlation between eggs and hatched Mirids of the same fortnight. Population increases could not be predicted

from egg counts, however. Observations on egg distribution showed that with increased spacing of the trees, more eggs are laid in the lower or middle canopy levels, whereas most are found in the upper canopy in more closely spaced trees.

In connection with work on swollen-shoot in Nigeria, investigations on regeneration of the trees by coppicing are recorded by J. M. Thresh. Coppiced trees spray-painted at monthly intervals with 1 per cent. DDT or 0·1 per cent. γ BHC were protected against Mirids [*Sahlbergella singularis*] but not from *Earias biplaga* Wlk. An experiment on Mirid control on mature cacao is described by R. G. Donald. Five-acre plots were treated with γ BHC at 4 oz. per acre in a dust applied by hand apparatus in September and October, treatment thereafter being confined to damaged trees and those in contact with them, or with various γ BHC mist sprays; in these, γ BHC was applied from August to February at monthly intervals at 2 or 4 oz., or at intervals of eight weeks at 4 oz., in 5 gals. spray per acre by portable motor-driven mist blowers or monthly at 4 oz. in about 10 gals. per acre by pneumatic knapsack sprayers, or in August and September at 4 oz. in 5 gals. spray per acre by the motor blowers, followed by spot treatment of damaged trees and those in contact with them with 4 oz. γ BHC in 10 gals. per acre applied by the knapsack apparatus. All treatments ceased in February. Records taken monthly from marked trees showed that the population declined rapidly on all treated plots during the first 2–3 months and continued to decline thereafter for the continuous treatments, of which the monthly application of 4 oz. γ BHC was the best. Spot spray treatment permitted some increase in numbers, and the dust a rather greater one. Populations increased on the untreated plots, reaching peaks in October and January. Damage assessments closely paralleled the population counts. The yields obtained during the work were anomalous, and definite results were not expected until the end of the season.

Caswell (G. H.). **Grain Storage Problems in southern Nigeria.**—*Divl Rep. Fac. Agric. Univ. Coll. Ibadan* (Ent.) no. 2, [1+] 8 pp., multigraph. Ibadan, 1956.

The principal insect pest of stored cacao in southern Nigeria is *Lasioderma serricorne* (F.). It attacks a wide variety of other materials and is able to survive between crops on alternative foods, notably stored tobacco. The female lays about 50 eggs among the beans during its life, which lasts 3–4 weeks, and the larvae enter the beans and feed and pupate in them, giving rise to adults in 60–90 days. Cacao is not the preferred food, development from egg to adult lasting only 30 days in flour and about 35 days in cowpeas or maize, and the beetle is difficult to control when the beans are stored in bulk.

The main pest of stored maize in the area is *Calandra oryzae* (L.). Infestation begins in the field, and 20 per cent. of the grains usually show exit holes a month after harvest. If control measures are not adopted, infestation may reach 100 per cent.

Caswell (G. H.). **Observations on the Biology of** *Callosobruchus maculatus* **F. (Coleoptera: Bruchidae).**—*Divl Rep. Fac. Agric. Univ. Coll. Ibadan* (Ent.) no. 3, [1+] 9 pp., multigraph. Ibadan, 1956.

Callosobruchus maculatus (F.) is the principal pest of stored cowpeas in Nigeria, causing an annual loss estimated at some £300,000. Observations on its bionomics showed that the females lay an average of about 55 eggs each on the cowpeas, half of them being laid in the first two days after emergence, and there was a tendency for fewer eggs to be laid between July

and October (the wet season). Fertilised females died after about six days, but unfertilised ones lived for up to twice as long, and experiments in which males were allowed to pair with females of various ages up to ten days indicated that this increased length of life is gained at the expense of egg production and by resorption of eggs already partly or completely matured. The few eggs laid by unfertilised females do not hatch. Mortality between oviposition and adult emergence averaged 45 per cent. It occurred mostly in the larval stage, which, with the pupal stage, is passed in the cowpeas, and showed no seasonal fluctuation. When effective temperatures were taken as the mean of the mean maximum and minimum monthly temperatures, the peak of adult emergence occurred 23–25 days after oviposition in March, November and February, when the effective temperature was highest (80°F.), and 30–31 days after it in July–August, when it was lowest (75°F.); males and females were about equally numerous.

The peak of emergence in each month was well defined, but it was followed after some days by a smaller peak. These late-emerging adults included females in which the pygidium was completely white, instead of black with a narrow white stripe down the centre, and the markings on the elytra more clearly defined. Such females flew readily and were much more rapid in movement than normal ones, which are lethargic; their occurrence has also been observed by S. Utida in Japan. They appeared every month, consistently emerging 5–6 days after the normal peak, but were commonest between March and June, at the beginning of the wet season. Attempts to breed this form failed, partly because the ovaries do not become developed until a fortnight after emergence and degenerate after a further week. Unfertilised females survived for 2–3 months. There was some evidence that development proceeded normally up to pupation but was then delayed, and adults of this form tended to emerge from cowpeas on which more than one egg had been laid. The significance of readiness to fly in this Bruchid, including the possibility of infestation of cowpeas in the field, is briefly discussed.

Eastop (V. F.). **A Study of the Aphididae (Homoptera) of East Africa.**—*Colon. Res. Publ.* [no. 20], $9\frac{3}{4}$ × 6 ins., vi + 126 pp., 63 figs., 10 pp. refs. London, Colon. Off., H.M.S.O., 1958. Price £1 7*s.* 6*d.*

The area covered by this book comprises Kenya, Tanganyika, Uganda, Pemba and Zanzibar, and about 80 species of Aphids are recorded from it, including one new one and a new subspecies. Keys are given to the genera and species, together with notes on their characters, food-plants and distribution and sometimes on the bionomics or other aspects of the species. A few Aphids that do not occur in East Africa but are present in adjacent territories or are almost world-wide in distribution are included. It is pointed out in the introduction that few Aphids are indigenous in the area, most of those now occurring in it having apparently been introduced with crop plants from Europe. The number of species representing each genus is therefore usually small. Production of sexuales is rare, owing to the tropical climate, and no migration from secondary to primary food-plants is known. There is a marked seasonal periodicity of flight [*cf. R.A.E.*, A **45** 315].

Peters (D. C.) & Painter (R. H.). **A general Classification of available small seeded Legumes as Hosts for three Aphids of the "Yellow Clover Aphid Complex".**—*J. econ. Ent.* **50** no. 3 pp. 231–235, 1 fig., 4 refs. Menasha, Wis., 1957.

Myzocallis (*Therioaphis*) *maculata* (Buckt.) (also known as *Pterocallidium* sp.), *M.* (*Pterocallidium*) *trifolii* (Monell) and *M.* (*Myzocallidium*) *richmi*

(Börn.) all feed on small-seeded leguminous plants in the United States [*cf. R.A.E.*, A **45** 11]. Investigations on their food-plant ranges were carried out by exposing young plants of more than 70 species in 12 genera (mostly forage crops) to infestation in the greenhouse, and supplemented by a few field observations in Kansas in the autumn of 1955.

In the greenhouse, *M. riehmi* infested all the species tested in the genera *Melilotus* (sweet clovers) and *Trigonella* but no other plants, *Myzocallis maculata*, all those in *Medicago* (including lucerne) and *Trigonella*, most of the species of *Melilotus* and a few of *Trifolium* (clovers), and *Myzocallis trifolii* all in *Trifolium*, most of those in *Trigonella* and some in *Medicago* and *Melilotus*, but 12 species in these four genera and all those tested of other genera were resistant or immune to all three. About 15 of the plant species studied were susceptible to *Myzocallis riehmi* and about 30 to the other two Aphids; lucerne was not attacked by *M. riehmi* or *M. trifolii*, and most *Melilotus* plants were not much injured by *Myzocallis trifolii* or *M. maculata*. Three species of *Melilotus* and three of *Trigonella* were about equally susceptible to all three. Within most of the susceptible species studied, individual plants differed in reaction to one or more of the Aphids.

In the field, *Myzocallis maculata* was observed on lucerne and three other species of *Medicago*, *Myzocallis trifolii* on red and zigzag clover (*Trifolium pratense* and *T. medium*) but not on three other species of the genus, and *M. riehmi* on *Melilotus* spp., but none of the Aphids was taken on plants of 12 other genera.

Sherman (M.) & Tamashiro (M.). **Control of Insect and Mite Pests of Beans in Hawaii.**—*J. econ. Ent.* **50** no. 3 pp. 236–237, 1 ref. Menasha, Wis., 1957.

In tests in which wettable-powder sprays were applied to small plots of green beans in Hawaii on 10th May 1955, 2 lb. 25 per cent. heptachlor or EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate], 2·5 lb. 10 per cent. endrin, 1 lb. 25 per cent. isodrin and 1 or 2 lb. 50 per cent. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.] per 100 U.S. gals. all controlled *Empoasca solana* De Long and *Thrips tabaci* Lind., EPN gave excellent and Strobane (at 2 lb.) and isodrin good control of *Trialeurodes vaporariorum* (Westw.), and EPN, isodrin and endrin good control of *Tetranychus telarius* (L.). When applied on 13th July, 5 lb. 95 per cent. wettable sulphur per 100 U.S. gals. practically eliminated *Hemitarsonemus latus* (Banks) for four weeks, and emulsion sprays of malathion or schradan gave fairly good protection for about 3–4 weeks. Plots treated with other materials rapidly became re-infested and required further treatment on 28th July, and on these, demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] in emulsion sprays and ovex [p-chlorophenyl p-chlorobenzenesulphonate] and Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] in wettable-powder sprays gave fairly good control, whereas wettable malathion did not.

Pence (R. J.). **The prolonged Maintenance of the Western Subterranean Termite in the Laboratory with Moisture Gradient Tubes.**—*J. econ. Ent.* **50** no. 3 pp. 238–240, 3 figs. Menasha, Wis., 1957.

Reticulitermes hesperus Banks has proved difficult to maintain in the laboratory, as it is sensitive to adverse environments, and the author describes a simple technique for duplicating the field conditions to which it

is accustomed. A porous plaster core, about 40 ins. long and one inch in diameter, was fitted into a glass tube, 48 ins. long and 2 ins. in diameter, which was placed on end in a petri dish containing water. As the water rose up the plaster, it created a moisture gradient, and termites were poured into the tube and left to seek their optimum moisture requirements. They congregated at a relative humidity of 97·5 per cent., about 8–10 ins. above the water line. Pieces of wood were put in the tube at this level for food, and the termites remained healthy for more than 13 months under these conditions.

The same conditions can be produced in standard 8-in. test-tubes, and a microscopic study of the feeding habits of *R. hesperus* was carried out with these. Sound wood that had been disinfected and dyed black with Indian ink was provided, and the guts of most of the termites became completely filled with the black wood in ten hours, the blackened abdomens being clearly visible against the white plaster of the core; sound wood was thus acceptable as food. When the dyed wood was treated with an insecticide, periodic examination of the termites indicated whether the insecticide was ingested, whether it was effective as a contact poison or whether the termites refused to feed and died of starvation. Wood dyed black was readily attacked in natural light, whereas the same wood undyed was largely ignored in light and accepted in darkness. In continuous artificial light, the dyed wood was definitely preferred, but feeding continued on the undyed portions after the black layer had been consumed. This is of interest in view of the fact that subterranean termites are generally considered to be blind.

Smith (R. H.). **Habits of Attack by the Black Turpentine Beetle on Slash and Longleaf Pine in North Florida.**—*J. econ. Ent.* **50** no. 3 pp. 241–244, 3 figs. Menasha, Wis., 1957.

Since 1950, *Dendroctonus terebrans* (Ol.) has caused much destruction of pine trees in the south-eastern United States. It is usually most active in disturbed stands, such as those in which logging is in progress, and sometimes attacks 20 per cent. of the trees in a single season. Observations on the habits of this bark-beetle were made in northern Florida in 1952–55, mainly on slash pine (*Pinus elliottii*), but also on longleaf pine (*P. palustris*). They showed that the adults fly to the trees and bore inwards to the cambium and then downwards to form egg galleries. The larvae bore in the phloem and pupate there or in the bark, through which the adults emerge. The first attacks are few in number and confined to the basal 18 ins. of the trunk. A few were made above this height towards the end of the first month, when the numbers averaged 4·7 per tree, and the attacks increased in number and height over a period of 5–7 months. When they were allowed to continue until the trees died, they averaged 28·6 per tree, about 85 per cent. occurring in the basal 36 ins. and only 2–3 per cent. above 72 ins. Entries more than 18 ins. from the ground are apparently made by beetles that first reach the tree below that height, as spraying the basal 18 ins. gave complete protection from attack; where trees were already infested, spraying to the height of the highest attack prevented subsequent entries in and above this zone. Monthly observations showed that attacks on a tree tended to be scattered over a period of 5–7 months, with a peak during the second and third month, and that the beetles were active throughout the year, but increased suddenly in importance in March and April and caused 90 per cent. of the damage in April–October. There was a close parallel between the number of attacks and the incidence of initially attacked trees. The average number of attacks per tree increased from six in those with diameters of 5 ins. at breast height to 15 and 21 in those with diameters of

20 and 41 ins., but their position on the tree showed no relation to diameter within the limits of 9–17 ins.

Mount (R. H.) & Arant (F. S.). **Effects of BHC with high and low Gamma Isomer Content and of Lindane upon the Cotton Aphid.**—*J. econ. Ent.* **50** no. 3 pp. 251–255, 1 graph, 5 refs. Menasha, Wis., 1957.

In view of the possibility that instances of poor control of *Aphis gossypii* Glov. recently given by BHC on cotton in the United States [*cf. R.A.E.*, A **42** 96] may have been due to the use of material of higher γ-isomer content than was formerly used, two field experiments and a laboratory study were carried out in Alabama in 1954 and 1955 in which various formulations prepared from BHC with different γ-isomer contents (100, 40 and 15·1 per cent.) were compared against the Aphid. Dusts containing 3 per cent. γ BHC were used in the field experiments, and the results revealed no significant differences in effectiveness between them, but wide differences between experiments, one application of any formulation giving good control at Prattville in 1954 and even two failing at Prattmont in 1955, regardless of the γ-isomer content of the source materials, the preparation of the dusts by grinding or impregnation or the addition of 5 per cent. DDT to the final product. Emulsion sprays were used in the laboratory, and the results resembled those of the first field experiment, all formulations giving high Aphid mortality, with no significant differences between them. First-instar nymphs were significantly more susceptible than older nymphs or adults, the LD50's being 0·021, 0·044 and 0·072 mg. γ BHC per ml., respectively. Although the Aphid appeared to have developed some resistance to BHC at Prattmont, further research is needed before definite conclusions can be drawn.

Weaver (C. R.), Pruess (K. P.) & Parsons (J. L.). **Further Tests of Band Placement of Insecticides for Clover Root Borer Control.**—*J. econ. Ent.* **50** no. 3 pp. 255–256, 3 refs. Menasha, Wis., 1957.

More extensive tests on the control of *Hylastes* (*Hylastinus*) *obscurus* (Marsham) on red clover by applying insecticides to the soil in bands along which the seed is sown [*cf. R.A.E.*, A **44** 123] were carried out in seven localities in Ohio in 1954–56. In 1954, 0·75 lb. aldrin or heptachlor per acre gave satisfactory reductions in the larval population and increased the hay yields significantly when applied to a mixture of clover and oats, and 0·75 lb. aldrin or lindane [almost pure γ BHC] per acre gave significant control and tended to increase the yield, though the differences were not significant because of variations in the stand, in clover without a companion crop. These and nine similar tests in 1954–56 showed that 0·75 lb. aldrin, heptachlor or γ BHC per acre gave an average of 89·3 per cent. control and increased the yields of hay in the second and third cuttings, where these were measured, in all but one case. Since this method of application did not prove successful for clover grown with wheat, the clover seed was mixed with a granular formulation of 10 per cent. aldrin and sown in wheat to give doses of 0·75 or 1·5 lb. toxicant per acre in March 1955. Sampling in August 1956 showed 1·48 larvae per root in untreated plants and 0·35 and 0·06 for the lower and higher doses of aldrin, respectively.

The usual rotation of maize, small grain and clover was carried out on the land treated in 1952–53 [*loc. cit.*], and the average population per clover root in 1956 was 3·31 for treated and 3·67 for untreated plots, indicating that the effectiveness of the treatment does not persist from one rotation to the next.

Frick (K. E.). **Comparative Toxicity Tests as an Aid in selecting Insecticides for Control of the Cherry Fruit Fly.**—*J. econ. Ent.* **50** no. 3 pp. 256–259, 2 graphs, 7 refs. Menasha, Wis., 1957.

The following is based on the author's introduction and summary. *Rhagoletis cingulata* (Lw.) is the most important pest of cherries in the Yakima Valley of Washington, and investigations were carried out to find an insecticide toxic to the adults that would leave no visible residue on the fruits, remain effective for 10–14 days, be of low mammalian toxicity and also control other pests. In preliminary tests, 17 insecticides in emulsion sprays were compared with parathion in a spray chamber for contact toxicity, and the resulting LD50 and LD95 values, together with toxicity indices calculated for each level of toxicity according to the method of Sun [*R.A.E.*, A **38** 426] are shown in tables. Comparison of insecticides was mainly on the basis of the LD95. Of the phosphorus compounds, DDVP [dimethyl 2,2-dichlorovinyl phosphate], diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate], Pirazinon [O,O-diethyl O-2-propyl-4-methyl-6-pyrimidinyl phosphorothioate], Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate] and demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] each had a lower LD95 than parathion, TEPP [tetraethyl pyrophosphate] and Am. Cyanamid 4124 [O,O-dimethyl O-2-chloro-4-nitrophenyl phosphorothioate] were slightly less toxic than parathion, and EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate], Dipterex [dimethyl 2,2,2-trichloro-1-hydroxyethylphosphonate] and malathion were much less so. Of those not containing phosphorus, aldrin and heptachlor differed little from parathion, whereas Perthane [1,1-bis(p-ethylphenyl)-2,2-dichloroethane (ethyl-DDD)], chlordane, Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis-(p-chlorophenyl)-2-nitrobutane], Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.] and two formulations of methoxy-DDT (methoxychlor) were inferior to it. Ethyl-DDD was the most effective of this group, having a toxicity of one-fifth to one-fourth that of parathion. Diazinon and ethyl-DDD were the most promising for orchard use; the former proved slightly superior to parathion in field tests at the same dosage, and ethyl-DDD gave good control at 2–4 times the dosage required for parathion.

Rabb (R. L.), Steinhaus (E. A.) & Guthrie (F. E.). **Preliminary Tests using *Bacillus thuringiensis* Berliner against Hornworms.**—*J. econ. Ent.* **50** no. 3 pp. 259–262, 1 fig., 8 refs. Menasha, Wis., 1957.

The following is based on the authors' summary. Preliminary tests were carried out to investigate the possibility of using *Bacillus thuringiensis* for the control of *Protoparce quinquemaculata* (Haw.) and *P. sexta* (Joh.), both of which attack tobacco in North Carolina. Laboratory tests in California in 1955 showed that larvae of *P. quinquemaculata* were markedly susceptible to infection when an aqueous suspension of the spores was administered orally or by injection into the body cavity, and in a limited field trial in the same State, a spore suspension applied as a spray to infested tomato plants gave good mortality. In small-plot field tests against *P. sexta* on tobacco in North Carolina in 1956, counts made 72 hours after spraying showed that a suspension containing 2 g. spores per U.S. gal. was as effective as 0·015 lb. DDD (TDE) per U.S. gal. emulsion spray, when applied to the leaves at approximately 50 U.S. gals. per acre. DDD was more rapid in action, but this may be of minor importance, since larvae sprayed with the spore suspension ceased feeding almost immediately. The spores had little effect on larvae of *Heliothis* spp., mainly *H. virescens* (F.), feeding on the plants.

Godwin (P. A.), Jaynes (H. A.) & Davis (J. M.). **The Dispersion of radioactively tagged White-pine Weevils in small Plantations.**—*J. econ. Ent.* **50** no. 3 pp. 264–266, 3 figs., 8 refs. Menasha, Wis., 1957.

In the north-eastern United States, the overwintered females of *Pissodes strobi* (Peck), which infests white pine [*Pinus strobus*], disperse from their hibernation quarters and oviposit from mid-April to mid-June. Reports as to their capability of flight are conflicting, and as it affects the degree of control afforded by the sprays normally applied at their first appearance, 1,600 adults were tagged with radioactive scandium (^{46}Sc), applied as the chloride in solution by a technique already noticed [*R.A.E.*, A **45** 187], and liberated under pine trees in a plantation 900 ft. × 600 ft. in area in New York on 2nd September 1954, and their distribution determined at intervals until May 1955. Only 12 had moved from the release trees by 13th October, though 60–70 per cent. of those liberated were still active. There was heavy winter mortality, and only 109 were found alive on 22nd April, of which 31 had already left the release trees and another 29 left them by 28th April. There was further movement by 11th May, and the distribution pattern suggested the occurrence of direct uninterrupted flights of 300–400 ft., the distance from the release trees to the edge of the plantation, and total movements covering at least 724 ft.

It is concluded that experimental plots should be separated from infested areas by at least 800 ft., that failure to remove any infested leaders observed after a spray operation will result in general infestation of the plantation after emergence, and that the practice of spraying a few trees round the infested ones to remove this residual population is of doubtful value. The plantation was bounded by a belt of hardwoods, and the accumulation of beetles along the edge of the latter suggested that a hardwood overstory acts as a mechanical barrier to penetration by the weevil.

Gibson (A. L.). **Tests of Bark-penetrating Insecticides to control the Douglas-fir Beetle.**—*J. econ. Ent.* **50** no. 3 pp. 266–268, 2 refs. Menasha, Wis., 1957.

Dendroctonus pseudotsugae Hopk. has caused serious losses of Douglas fir [*Pseudotsuga menziesii*] in the western United States in the last 25 years, and the increased value of the timber from this tree led to investigations on methods of control. Experiments were carried out over three years in forests in Montana and Idaho, in which solutions of o-dichlorobenzene, trichlorobenzene, dichloroethyl ether and ethylene dibromide (this last with Triton X-100) in diesel oil (1:3–1:5) and emulsions prepared from 2 lb. ethylene dibromide, 8 oz. Triton X-100 and Triton B-1956, 4–6 lb. diesel oil and 4–4·25 U.S. gals. water, were applied to run-off to infested standing trees and logs; the latter were rotated and sprayed until all surfaces were covered. Some of the logs were sprayed with water and others exposed to rain or snow before treatment. The solutions caused complete mortality of the immature stages in dry logs or standing trees and over 80 per cent. in wet logs or those with green cambium. The emulsions were almost as effective, the best (2 lb. ethylene dibromide, 5 lb. diesel oil and 4·125 U.S. gals. water, with 3 oz. Triton X-100 and 5 oz. Triton B-1956) permitting less than 6 per cent. survival in dry or wet wood. The bark of Douglas fir was found to be very absorbent, but green cambium resisted penetration by either emulsions or solutions, as was shown by the incomplete mortality achieved in it. When treatments were applied in autumn, the insecticides caused some mortality before winter, but were not completely effective until after a period of warm weather in the following year, possibly because the higher temperature volatilised the toxicants.

Bobb (M. L.). **Insecticides for Control of Peach Insects.**—*J. econ. Ent.* **50** no. 3 pp. 268–269, 4 refs. Menasha, Wis., 1957.

The results are given of field experiments in which insecticides were applied in concentrated sprays to peach in Virginia for the control of *Conotrachelus nenuphar* (Hbst.), *Cydia* (*Grapholitha*) *molesta* (Busck) and insects causing cat-facing of the fruits, of which *Lygus lineolaris* (P. de B.) was the chief. The quantities of insecticide given are per 100 U.S. gals.

In 1954, when three sprays were applied against the first and one against the second generation of *Conotrachelus*, on 14th April (sepal-split), 23rd April (sepal-fall), 30th April and 2nd July, 1 lb. 50 per cent. wettable dieldrin, with the addition of 4 lb. 50 per cent. wettable DDT in the sepal-fall spray, gave 99·7 per cent. reduction in infested fruits at harvest, 3 and 4 lb. 15 per cent. wettable parathion and 2 lb. 25 per cent. wettable EPN [O-ethyl O-p-nitrophenyl phenylphosphonothioate] gave 81·5, 94·2 and 84·2 per cent. reduction and malathion, methoxy-DDT (methoxychlor) and endrin were unsatisfactory. No sprays were applied against the second generation of *Cydia*, and only parathion and EPN gave more than 75 per cent. reduction in fruit infestation by it.

In 1956, when sprays were applied on 27th April (sepal-split), 5th May (sepal-fall), 12th May, 6th June and 5th July, 3 lb. 15 per cent. wettable parathion, 1 U.S. pint 42 per cent. parathion emulsion concentrate, 1·5 lb. 25 per cent. wettable Guthion [O,O-dimethyl S-(4-oxo-benzotriazino-3-methyl) phosphorodithioate] (not applied at sepal-fall in some cases), 2 lb. 25 per cent. wettable EPN and 6 lb. 50 per cent. wettable methoxy-DDT gave complete control of *Conotrachelus* and 3 lb. 25 per cent. wettable Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], 6 lb. 25 per cent. wettable malathion and 0·5 lb. 50 per cent. wettable dieldrin very good control, but trees sprayed with 4 lb. 50 per cent. wettable DDT, on which 1·6 per cent. of the first-generation larvae were parasitised by *Triaspis curculionis* (Fitch), had more infested peaches at harvest than untreated ones, on which parasitism reached 17·3 per cent. The population of *Cydia* was low, and all materials afforded control. In another orchard block, petal-fall application of the wettable-parathion, malathion, EPN, dieldrin, methoxy-DDT and DDT sprays, made on 12th April, controlled cat-facing insects, all but methoxy-DDT reducing injury by 90 per cent. or more.

In laboratory tests, dipping first-generation adults of *Conotrachelus* in liquids containing 1·5 lb. 15 per cent. wettable parathion, 0·5 U.S. pint 42 per cent. parathion emulsion concentrate, 0·25 lb. 50 per cent. dieldrin, 3 lb. 25 per cent. malathion or 1 lb. 25 per cent. diazinon [O,O-diethyl O-2-isopropyl-4-methyl-6-pyrimidinyl phosphorothioate] per 100 U.S. gals. gave complete mortality within five days, 2 and 4 U.S. pints of an emulsion concentrate containing 48·5 per cent. Thimet [O,O-diethyl S-ethylthiomethyl phosphorodithioate] gave 80 and 90 per cent. kill, respectively, and demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] had no appreciable effect.

Walton (R. R.), Arbuthnot (K. D.) & Brooks (J. S.). **Further Tests with Insecticides to control the Southwestern Corn Borer.**—*J. econ. Ent.* **50** no. 3 pp. 270–271, 2 refs. Menasha, Wis., 1957.

In further tests on the control of the larvae of *Zeadiatraea* (*Diatraea*) *grandiosella* (Dyar) on maize in Oklahoma [*cf. R.A.E.*, A **43** 249], nine insecticides applied twice at 0·5 lb. per acre in 35 U.S. gals. water with a fixed-boom sprayer and five applied twice at the same rate in granules with a rotary hand duster were ineffective against the first-generation in 1954. Several treatments applied by hand equipment were tested in July–September 1955, although the borer population was too low to give conclusive

results; the plants were artificially infested in two of the three experiments. When endrin was used at 1 lb. per acre, application of emulsion sprays to the entire plant, to the ear zone and (from above) to the top of the plant reduced the numbers of damaged plants and (in brackets) of borers per test from 10·4 (14) to 2·2 (1·8), 0·6 (0·6) and 2·6 (1·8), respectively, and application in 10, 35 and 100 U.S. gals. spray per acre reduced them to 4 (2·4), 2 (1·2) and 0·4 (0); application in granules followed by spraying with 0, 10 and 100 U.S. gals. water per acre reduced them to 2·8 (3·6), 2·8 (1·2) and 0·4 (0·4), suggesting that light rain after application would improve the effectiveness of granules. When endrin was applied at 1 lb. per acre in a spray and 0·3–0·67 lb. in granules, the figures were 2·1 (1·3) and 2·5 (2·2), indicating that, at equal rates of application, granules would be as effective as sprays, when two applications of endrin sprays were made five or eight days after eggs were first found or put on the plants, and again a week later, they were 1·5 (1) and 0·5 (0), and when single applications were made 5, 8 or 12 days after eggs were first recorded, they were 2 (2), 4 (2) and 1 (1), respectively. In a test in which Am. Cyanamid 12008 [O,O-diethyl S-isopropylthiomethyl phosphorodithioate], Am. Cyanamid 12009 [O,O-diethyl S-propylthiomethyl phosphorodithioate], Phosdrin [dimethyl 2-methoxycarbonyl-1-methylvinyl phosphate], Sevin [1-naphthyl N-methylcarbamate], Thimet [O,O-diethyl S-ethylthiomethyl phosphorodithioate] and endrin were applied at 1 lb. in 35 U.S. gals. spray per acre against a natural infestation, in which hatching occurred over a period of several days, endrin reduced the numbers of damaged plants and (in brackets) borers from 11·3 (16) to 2 (2), whereas the other materials reduced them to 4–9·3 (5·3–12). All were equally effective against artificial infestations, since the larvae all hatched within four days and a lasting deposit was not required.

Kerr (T. W.). **Leafhoppers associated with Forage Crops in Rhode Island.** —*J. econ. Ent.* **50** no. 3 pp. 271–273, 4 refs. Menasha, Wis., 1957.

During investigations in 1948–49 and 1951–56, 14 species of leafhoppers were swept from forage crops of lucerne, red clover and various mixtures of grasses and leguminous plants in Rhode Island. The most abundant was *Macrosteles fascifrons* (Stål), which was taken on all three types of crop and appeared to have three generations a year, the adults being present from mid-May until late October. Other species that occurred in relatively large numbers on all three were *Endria inimica* (Say) and *Graminella nigrifrons* (Forbes), which had two and three generations a year, respectively, the adults being present from June until late October, *Empoasca fabae* (Harris), which was taken in small but consistent numbers throughout the season, mainly on lucerne, and *Agallia constricta* Van D., *Aceratagallia sanguinolenta* (Prov.) and *Dracculacephala antica* (Wlk.), which apparently had two generations a year, with adults present from May until late September, late October and early October, respectively. A table shows their abundance on the various crops in different years.

Evans (W. G.), Neunzig (H. H.), Gyrisco (G. G.) & Richmond (R. G.). **Aerial Applications of granulated Dieldrin for Control of Larvae of the European Chafer on hilly Meadows and Pastures.**—*J. econ. Ent.* **50** no. 3 pp. 273–276, 1 fig., 2 refs. Menasha, Wis., 1957.

Since most of the grassland infested by larvae of *Amphimallon majalis* (Razoum.) in central New York occurs in hilly country and cannot be rapidly treated by ground machine, tests were made to determine whether granular insecticides that had proved effective in earlier tests [*cf. R.A.E.*, A **44** 234]

could be applied successfully by aeroplane. The following is based on the authors' summary of the work.

Four large hilly areas were treated by aeroplane on 20th April 1954 with 0·73–3·58 lb. actual dieldrin per acre, and counts made in September 1954 and October 1955 showed that excellent control was obtained of two successive generations of larvae. Air currents greatly affected the deposits over the hilly terrain, and measurements made by means of aluminium collecting cones and plates coated with adhesive showed that they were irregular and usually did not approach the amounts desired. The insecticide residues on the foliage nine days after treatment were higher than expected, partly owing to the poor consistency of the granules, which broke during transport, resulting in a high proportion of fine material. Drift was greater than expected, extending over 300 yards, but surveys made before and after treatment showed no appreciable change in the population of field mice and no toxicity to fish in neighbouring streams.

Stevenson (W. A.), Kaufman (W.) & Sheets (L. W.). **The Salt-marsh Caterpillar and its Control in Arizona.**—*J. econ. Ent.* **50** no. 3 pp. 279–280. Menasha, Wis., 1957.

Estigmene acraea (Dru.), which was previously of little importance on cotton in Arizona [*cf. R.A.E.*, A **43** 217], became extremely numerous in the Salt River Valley in the autumn of 1948, causing some damage, particularly in late-planted fields, and migrating from cotton to other crops, including lettuce and sugar-beet.

Preliminary tests in 1947 had shown a 20 per cent. toxaphene dust to be more promising than other insecticides for control of the larvae, and in field-cage tests with dusts (all containing sulphur) on infested cotton in 1948, 20–25 lb. 15 per cent. toxaphene with 5 per cent. DDT, with 1 per cent. γ BHC or with 5 per cent. chlordane per acre gave 97, 94 and 93 per cent. mortality in 96 hours, whereas 15 and 20 per cent. toxaphene without additives, 5–10 per cent. toxaphene with either BHC or DDT, 10 per cent. chlordane, with or without DDT, and a mixture of DDT and BHC were less effective. In small-plot tests, 20 lb. per acre of a dust containing 15 per cent. toxaphene, 5 per cent. DDT and 40 per cent. sulphur gave high mortality on cotton and also on sugar-beet grown for seed. The same dust gave 95 per cent. control when applied to cotton by aeroplane at 20–25 lb. per acre late in 1949 and 1950, and spray applications of 3 lb. toxaphene with 1 lb. DDT in 7·5 U.S. gals. emulsion per acre were equally effective, and superior to 3 lb. toxaphene alone. The mixture of toxaphene and DDT became widely used on cotton and continued to give good control until the autumn of 1954, when sufficient larvae to cause economic damage survived high dosages. Parathion at high rates in sprays gave practically complete kill, but was not recommended because of the risks involved. In 1955, the mixture of toxaphene and DDT again gave poor results, and laboratory tests showed that larvae from Arizona needed four times the dosage required for equivalent mortality by those from Texas, indicating the development of some resistance.

As Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane] had given good kills of the larvae in cage and field tests in Texas in which a 3 per cent. dust was applied at 20–25 lb. per acre in 1949, it was tested in Arizona in 1955. When applied in an emulsion spray, 1·25 lb. technical Dilan per acre killed more than 95 per cent. of the larvae and 0·625–1 lb. per acre gave good control; it was slower in action than toxaphene and DDT, but caused high mortality of larvae confined on leaves sprayed ten days previously.

The larvae were parasitised by *Tachina* (*Exorista*) *larvarum* (L.) and *Leschenaultia* (*Rileymyia*) *adusta* (Lw.), which gave considerable control but were susceptible to insecticides [*cf.* **43** 218]. *Estigmene* larvae collected early in the winter of 1950 gave rise to adults mainly in April and May, but small numbers emerged in June and July and a few in January, August and September.

Hacskaylo (J.). **Growth and Fruiting Properties and Carbohydrate, Nitrogen and Phosphorus Levels of Cotton Plants as influenced by Thimet.**—*J. econ. Ent.* **50** no. 3 pp. 280–284, 2 figs., 5 refs. Menasha, Wis., 1957.

As Thimet (O,O-diethyl S-ethylthiomethyl phosphorodithioate), applied to cotton seeds in a carbon-impregnated dust, has been found to give excellent control of certain insects attacking the plants for up to six weeks after germination, but to have some phytotoxic properties [*cf. R.A.E.*, A **46** 174], investigations were made on the physiological effects of the compound on the plants under optimum conditions of growth. The following is based on the author's summary of the work.

Cotton plants grown in the greenhouse in sand cultures, to which aqueous emulsions containing technical Thimet were added on the tenth day after germination to give concentrations of 10, 100 or 500 parts per million in the nutrient-solution phase of the substrate, all showed initial wilting, but recovered. Slight to severe necrotic flecking of the leaves developed, and was correlated with the concentration of Thimet in the substrate. Final dry weights were slightly greater for plants treated with the lowest concentration than for those in untreated substrate, but successively less than the controls at 100 and 500 p.p.m., and the number of bolls retained, the yield of seed cotton and the number of seeds per boll and weight of lint per 100 seeds were comparable for no treatment and the two lowest concentrations, but reduced at 500 p.p.m. All treatments with Thimet resulted in larger seed embryos and tended to cause an increase in their oil content at the expense of protein formation, but there was no effect on the percentage germination (about 92) or seedling vigour.

The contents of reducing sugars, sucrose and starch in young plants and of phosphorus, soluble and insoluble in chloroform, in their leaves tended to increase, and those of soluble and protein nitrogen to decrease, with increasing concentrations of Thimet.

Madsen (H. F.) & Hoyt (S. C.). *Schizura ipomaeae* **Dbldy. attacking Plums in California.**—*J. econ. Ent.* **50** no. 3 pp. 284–287, 4 figs., 4 refs. Menasha, Wis., 1957.

The following is based largely on the authors' summary. Larvae that caused considerable damage to plum trees, sometimes resulting in complete defoliation, in the Marysville district of California in 1953 were identified as *Schizura ipomaeae* Dbd. Field observations over three seasons showed that this Notodontid overwinters as a prepupa in the soil, where it pupates in April. The adults emerge in May, and the eggs are laid on the lower surfaces of the leaves. The young larvae feed on the lower leaf surface and the older ones on the leaf margins, eating to the midrib. The larvae drop to the ground in June, when full-fed, and pupate in the soil. First-generation adults emerge in mid-July and oviposit mainly on sucker shoots. The generations overlap to some extent, so that larvae of both may be present together. Second-generation larvae drop to the soil in September. Control

was readily obtained with a DDT spray directed against the young larvae in late May or early June, but older ones were more difficult to kill.

Frost (S. W.). **The Pennsylvania Insect Light Trap.**—*J. econ. Ent.* **50** no. 3 pp. 287–292, 7 figs., 2 refs. Menasha, Wis., 1957.

Previous results published by the author on the effectiveness of traps using ultraviolet light for the capture of insects [*R.A.E.*, A **44** 117, etc.] were obtained with the Minnesota trap, in which bulb lamps are used. The Pennsylvania light-trap, which is here described, uses a tube lamp. It is constructed of aluminium and consists of four vertical baffles 20 ins. high and 5·5 ins. wide, radiating from a 15-watt ultraviolet fluorescent tube, with ballast and starter, covered by a circular plate 25 ins. in diameter and mounted over a 60° funnel narrowing from 12 to 2 ins. in diameter, which is fitted with a screw cap to accommodate the killing-jar. This trap was compared with 12 others, some modifications of it, some using more than one tube lamp and some using round baffles and 32-watt tube lamps formed into a circle (circline lamps), and a New Jersey suction light-trap [*cf.* B **23** 151] fitted with a 100-watt inside-frosted white-light tungsten lamp, at State College, Pennsylvania, in June–October 1956. The results showed that the Pennsylvania trap was superior to the others in catching all insects but mosquitos and Tipulids, which were taken in greatest numbers in the New Jersey trap. Lowering the lamp and baffles into the funnel, to produce a more compact trap and give more protection from rain, reduced the catches only slightly and may be desirable. Reflection of light from the baffles of some of the modified traps reduced the catches, but this was largely overcome by painting the baffles black; covering them with black paper, to which the insects clung, was less satisfactory. A small heater placed in the funnel was of no advantage. The traps fitted with circline lamps compared favourably with the standard model, but are more expensive to construct and require larger ballast.

Dominick (C. B.). **Insecticides in Transplant Water for Prevention of Tobacco Flea Beetle Emergence.**—*J. econ. Ent.* **50** no. 3 pp. 292–293, 5 refs. Menasha, Wis., 1957.

In further tests on the effect of insecticides applied in the transplant water for the control of *Epitrix hirtipennis* (Melsh.) on tobacco in Virginia [*cf. R.A.E.*, A **43** 53], young tobacco plants were set with a hand-transplanter, and wettable powders or emulsion concentrates were applied in 100 ml. water to the hole round each plant. In 1954, heptachlor gave excellent, lindane [γ BHC] good, chlordane fair and demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] poor control, and in 1955, aldrin gave very good, γ BHC, chlordane and heptachlor good and dieldrin fair control; demeton was again less effective. In 1956, wettable-powder and emulsion formulations of heptachlor, aldrin and chlordane were compared; 4 fl. oz. heptachlor emulsion concentrate (2 lb. actual compound per U.S. gal.), 3 fl. oz. 75 per cent. chlordane emulsion concentrate and 4 oz. 25 per cent. wettable aldrin per 50 U.S. gals. water gave over 90 per cent. reduction in numbers of adult flea-beetles emerging from the soil round the plants, 4 fl. oz. aldrin emulsion concentrate (2 lb. per U.S. gal.) gave 88 per cent. reduction, and 4 oz. 25 per cent. wettable heptachlor or 50 per cent. wettable chlordane was less effective. It is concluded that the treatment is justified when hand-transplanters are used, but that it should not be considered as a substitute for foliage applications.

Jeppson (L. R.), Fleschner (C. A.), Jesser (M. J.) & Complin (J. O.). **Influence of Season and Weather on Citrus Red Mite Populations on Lemons in southern California.**—*J. econ. Ent.* **50** no. 3 pp. 293–300, 11 graphs, 6 refs. Menasha, Wis., 1957.

The following is based on the authors' summary. Populations of *Panonychus* (*Metatetranychus*) *citri* (McG.) were evaluated at weekly intervals in 1952–55 in untreated plots in four lemon groves in southern California, and related to seasonal growth and temperature and humidity records. The trends in mite population were found to be correlated with the seasonal growth cycles of the trees unless affected by weather conditions; populations tended to be highest during periods when there was most new foliage (spring and autumn), but low humidities accompanied by high temperatures and winds appeared to make new growth less favourable for development. Lemon trees produce enough new growth to sustain relatively high populations for most of the year, however, if weather conditions are favourable, and extremes of temperature and humidity were not common enough near the coast to depress the population for any extended period, whereas further inland and under more continental weather conditions, longer periods of the year were unfavourable for development.

Jeppson (L. R.), Jesser (M. J.) & Complin (J. O.). **Correlation of Spray Treatments with Citrus Red Mite Population Trends on Lemon Trees in southern California.**—*J. econ. Ent.* **50** no. 3 pp. 300–307, 29 graphs, 2 refs. Menasha, Wis., 1957.

The following is substantially the authors' summary. In 1952–55, populations of *Panonychus* (*Metatetranychus*) *citri* (McG.) on lemon in southern California were evaluated by weekly counts in two groves in which the trees were sprayed twice a year (with oil emulsion in August–January and ovex [p-chlorophenyl p-chlorobenzenesulphonate] in February–July) on 14–15 combinations of dates. The most effective control was obtained when the sprays were applied at the beginning of the major upward trends in population [*cf.* preceding abstract], and it is concluded that where weather conditions are unfavourable for summer population peaks, treatments applied in August and February–May afford control throughout the year, whereas where spring and summer weather does not prevent moderate to high summer populations, treatment in October–November and in late June or July is satisfactory. Orchards on the coastal plain, where mite populations begin to increase in June, should be treated in June and again in October or November.

Jeppson (L. R.), Jesser (M. J.) & Complin (J. O.). **Effectiveness of two new Phosphate Insecticides for Control of Mites injurious to *Citrus* in California.**—*J. econ. Ent.* **50** no. 3 pp. 307–310, 1 ref. Menasha, Wis., 1957.

Tests were made in southern California in 1954–56 of the effectiveness of Hercules AC-528 (2,3-p-dioxandithiol S,S-bis(O,O-diethyl phosphorodithioate)) and Trithion (O,O-diethyl S-p-chlorophenylthiomethyl phosphorodithioate) applied by conventional sprayer, boom sprayer and spray-blower for the control of *Panonychus* (*Metatetranychus*) *citri* (McG.) and other mites on *Citrus*. When applied at 4–12 and 2–12 oz., respectively, per 100 U.S. gals. at 1,500–2,000 U.S. gals. spray per acre by the first method, the materials generally gave good control of *P. citri*, effectiveness varying with the dosage applied, and 4 oz. AC-528 appeared adequate against all but very heavy infestations. Sprays of AC-528 prepared from emulsion concentrates were more effective than wettable-powder sprays in some tests, but not in

others. By the first two methods of application, AC-528 and Trithion were generally more effective than corresponding sprays of ovex [p-chlorophenyl p-chlorobenzenesulphonate], with or without Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite], or the standard sprays of oil emulsion, but had to be used at twice the concentration of demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] for equivalent control. When applied in 600 U.S. gals. emulsion spray per acre with the blower, 4 lb. AC-528 per acre proved effective on lemon and 5 lb. AC-528 and 3·5 lb. Trithion on orange. AC-528 and Trithion also gave good control of *Eotetranychus sexmaculatus* (Ril.) and *E. yumensis* (McG.), but were relatively ineffective against *Aceria sheldoni* (Ewing) and *Brevipalpus lewisi* McG.

Sivik (F. P.), Tenhet (J. N.) & Delamar (C. D.). **An ecological Study of the Cigarette Beetle in Tobacco Storage Warehouses.**—*J. econ. Ent.* **50** no. 3 pp. 310–316, 3 graphs, 10 refs. Menasha, Wis., 1957.

The life-history of *Lasioderma serricorne* (F.) was investigated in flue-cured tobacco under warehouse conditions in North Carolina during the summer of 1956. The egg, larval and pupal stages lasted about 7, 40 and 5 days, respectively, and the adults, which fed very little, if at all, lived for 1–6 weeks. Males and females occurred in general in about equal numbers, but there were periods during the summer when one sex or the other was the more prevalent. There are usually two generations and a partial third in the year in North Carolina, and winter is passed in the larval stage.

In a test in which 210 beetles were selected in the pupal stage, caged in pairs and kept with pieces of tobacco midrib at an average temperature of 85°F. and about 60 per cent. relative humidity, the females lived for 8–42 days and deposited 18–112 eggs each over periods of 2–18 days; 66 per cent. of the eggs were laid within four days after emergence and 98 per cent. within 11 days, and the females survived for 1–36 days after oviposition had ceased. In trapping tests to determine whether the heavier infestations observed on the top floors of warehouses and in the top tiers of hogsheads on each floor are due to the attraction of higher temperatures or to negative geotropism, more beetles were collected in heated than in unheated traps, but no more at higher than at lower levels when all traps were kept at the same temperature, indicating that temperature was the more important factor. When eggs were put on or in tobacco packed in tubes at the same density as in hogsheads, examination after 9–10 weeks showed that the larvae made galleries in all directions without a definite pattern; they penetrated the tobacco for distances of approximately 0·5–2·5 ins., and most of the resulting adults appeared to pair and oviposit at or near the site at which they had developed. Pairing was observed both inside and outside tobacco hogsheads.

Hetrick (L. A.). **Ten Years of testing organic Insecticides as Soil Poisons against the Eastern Subterranean Termite.**—*J. econ. Ent.* **50** no. 3 pp. 316–317, 1 ref. Menasha, Wis., 1957.

Investigations continued for a further five years, without renewal of toxicants, on the toxicity of various organic compounds in sandy soil to *Reticulitermes flavipes* (Koll.) [*cf. R.A.E.*, A **40** 229] showed that the action of DDT and methoxy-DDT (methoxychlor) at 1:200 and DDD (TDE) at 1:200 and 1:1,000 was more rapid in the second than in the first five years, that γ BHC continued to give rapid knockdown at 1:10,000 and 1:20,000 but had lost some of its effect at 1:50,000 and 1:100,000, and that the action of chlordane was slightly but consistently less rapid than before and appreciably less rapid than that of comparable doses of γ BHC. Toxaphene at concentrations below 1:1,000, pentachlorophenol at 1:200, and

sodium pentachlorophenate at 1:100–1:1,000 also showed reduced speed of action, but the last two are considered satisfactory if applied at adequate doses. In the third to seventh years of test at concentrations of 1:5,000–1:100,000, dieldrin gave extremely rapid knockdown at all concentrations, aldrin at concentrations of 1:25,000 or more and heptachlor at 1:5,000; aldrin and heptachlor, though less rapid at the lower concentrations than in the first two years [*loc. cit.*], were still very effective.

Howe (W. L.) & Smith (O. F.). **Resistance to the Spotted Alfalfa Aphid in Lahontan Alfalfa.**—*J. econ. Ent.* **50** no. 3 pp. 320–324, 3 figs., 4 refs. Menasha, Wis., 1957.

The following is based largely on the authors' summary. The spotted alfalfa Aphid [*Myzocallis maculata* (Buckt.)], here referred to as *Pterocallidium* sp., caused severe injury to most varieties of lucerne during its spread across the south-western United States in 1954–55 [*cf. R.A.E.*, A **45** 11], but the hardy Lahontan variety showed low Aphid populations and small accumulations of honeydew in comparison with others. Tests carried out in California in 1955–56 showed that it had a high level of resistance to infestation in both the seedling and mature stages of growth. When seedlings from random populations of Caliverde, African and Lahontan lucerne were infested in the greenhouse, all the seedlings of Caliverde but none of those of Lahontan were killed in two weeks; some seedlings of the African lucerne were tolerant of infestation, but almost all were killed or severely injured. When older plants of these varieties and polycross progenies of selected plants were tested in the field under plastic cages, to exclude predators and allow the Aphid to increase rapidly, Lahontan made excellent growth, whereas the other varieties were killed or showed severely injured tops. The manner in which the injury spread from single feeding sites suggested that a toxin acting systemically was concerned; if this is so, the resistance of the Lahontan variety would be due largely to tolerance of the toxin.

The value of a resistant variety was shown by field-plot tests in southern Nevada. In 1956, heavy populations injured and drastically reduced the first crop of hay of three-year-old stands of African, Caliverde and California Common 49 lucerne, but caused no injury to Lahontan, which produced excellent green forage. On the basis of dry weight per plot for the first crop, Lahontan yielded 2·89, 3·59 and 4·03 times as much as the other three varieties, respectively.

The levels of resistance in Lahontan and its five parental clones were determined by observing Aphid survival and reproduction on leaves of individually caged plant stems. Aphids placed on the leaves of three of them died within 48 hours, and those placed on the other two reproduced, but more slowly than on a susceptible variety. The first three were therefore classed as highly resistant, and the others as intermediate.

Ditman (L. P.), Owens (H. B.) & Harrison (F. P.). **Experiments with Sprays, Dust and Aerosols for the Home Garden.**—*J. econ. Ent.* **50** no. 3 pp. 324–328, 2 refs. Menasha, Wis., 1957.

Further tests on the control of insects on small crops of vegetables in Maryland by insecticides applied with hand equipment were made in 1952–55 [*cf. R.A.E.*, A **41** 74, etc.]. The effects of the treatments were judged mainly by crop yields.

In 1952, liquefied-gas aerosols containing 50 per cent. methyl chloride as the propellent and 2 per cent. toxaphene, 4 per cent. malathion, 5 per cent.

methoxy-DDT (methoxychlor), alone or with 1 per cent. rotenone or 2 per cent. Dilan [a 1:2 mixture of 1,1-bis(p-chlorophenyl)-2-nitropropane and 1,1-bis(p-chlorophenyl)-2-nitrobutane], or a mixture of 2 per cent. lindane [almost pure γ BHC] with 2 per cent. Dilan, all with enough methylene chloride (a volatile solvent) to complete the formulations, were applied weekly throughout much of the period of growth; they caused significant increases in yields of cabbage, attacked by *Phyllotreta* spp. and *Trichoplusia ni* (Hb.), and of snap beans, infested by *Empoasca fabae* (Harris) during the growing period and by *Epilachna varivestis* Muls. when nearly mature, but not of lima beans, which were infested by the same insects, tomatos, which were attacked by *Macrosiphum solanifolii* (Ashm.), *Heliothis zea* (Boddie) and *Protoparce quinquemaculata* (Haw.), or potatoes, infested by *M. solanifolii*. The results were inconsistent on cucurbits, but aerosols containing methoxy-DDT did not control infestation by *Aphis gossypii* Glov., and those containing toxaphene damaged the plants.

In 1954, similar aerosols containing mixtures of 5 per cent. malathion with 5 per cent. toxaphene, 2 per cent. Dilan, 2 per cent. Strobane [a chlorinated mixture of α-pinene isomers with a chlorine content of about 66 per cent.] or 1 per cent. pyrethrum, of 5 per cent. malathion with 1 per cent. pyrethrum and 5 per cent. DDT, or of 2 per cent. Strobane with 1 per cent. pyrethrum increased the yields of snap beans infested by *Tetranychus atlanticus* McG., and all but malathion with Dilan or Strobane increased those of cabbage infested by *Trichoplusia ni* and *Brevicoryne brassicae* (L.). Aerosols containing toxaphene or Strobane damaged cucurbits and did not appear suitable for general use, and methoxy-DDT and pyrethrum showed less insecticidal effect than other materials and are not considered promising. On the basis of these results and toxicity to mammals [*cf. loc. cit.*], γ BHC, Dilan and malathion are considered the best materials for use in a general formulation, though γ BHC affected the flavour of potatoes objectionably and that of some other vegetables very slightly.

In 1953, a dust and an aerosol containing 4 per cent. malathion and a spray of 1 quart 55 per cent. malathion emulsion concentrate per 100 gals., applied at about weekly intervals to give average quantities of 2·75, 0·69 and 0·83 lb. toxicant per acre per application, respectively, had no significant effect on yields of cucurbits, tomato or potato; the dust caused significant increases of lima beans, and the dust and spray of snap beans. All three formulations caused significant yield increases in cabbage, on which the dust was significantly more effective than the spray or aerosol. Insecticidal effect tended to vary with the amount of actual toxicant applied, and the aerosol did not deposit enough to give satisfactory results.

In 1955, when sprays containing 1·5 pints of the malathion concentrate per 25, 50 or 100 gals. water were applied at about 30 U.S. gals. per acre, the yields of lima beans and cucumbers were increased and the injury to the bean leaves by *Epilachna varivestis*, *Cerotoma trifurcata* (Forst.) and *Tetranychus atlanticus* and the numbers of *Leptinotarsa decemlineata* (Say) per plot of potatoes were reduced approximately in accordance with the concentration. A spray of 1 lb. DDVP [dimethyl 2,2-dichlorovinyl phosphate] per 100 U.S. gals., applied at 28·6 U.S. gals. per acre, gave promising results against the pests on lima beans.

Guthrie (F. E.), Rabb (R. L.), Baron (R. L.) & Flynn (J. E.). **Methods and Materials for controlling Budworms on Flue-cured Tobacco.**—*J. econ. Ent.* **50** no. 3 pp. 328–332, 2 figs., 5 refs. Menasha, Wis., 1957.

Heliothis virescens (F.) and *H. zea* (Boddie) are among the most important pests of flue-cured tobacco in North Carolina, and are difficult to control

as the larvae feed within the terminal buds. Several insecticides, methods of application, dosage rates, spray volumes and nozzle arrangements were tested in 1955–56. Plants 45–60 days old were artificially infested with eggs or larvae to produce a uniform heavy infestation consisting so far as was known exclusively of *H. virescens*, and treated 4–5 days later in 1955 and 1–5 days later in 1956. Counts of larvae eight days after treatment showed that the best control was obtained when the insecticides were applied directly into the bud. A pinch of 1·5 per cent. endrin dust in the bud was as effective as the same dust applied with a rotary hand duster or as a pinch of a bait of DDT and maize meal (1 : 75) or a pinch of 10 per cent. DDD (TDE) dust and tended to be more effective than 10 per cent. DDT dust applied with the duster or a bait of lead arsenate and maize meal. Emulsion sprays of DDT, endrin or DDD were effective when applied with hand sprayers, but mechanical sprayers gave poor results in the early treatments, regardless of nozzle arrangements, volume applied, pressure used or dosage of insecticide, and shaking a perforated can or cheese-cloth sack of DDT dust over each bud was also unsatisfactory. The best results were normally obtained by treatment soon after infestation. When it was delayed until five days after, damage was much greater, but the lead-arsenate bait and treatments with the power sprayer gave better results, possibly because the larger larvae sometimes leave the buds. Thimet [O,O-diethyl S-ethylthiomethyl phosphorodithioate], applied in the transplant water, was ineffective.

Medler (J. T.) & Brooks (G. N.). **Insect Control in Relation to Alfalfa Seed Production in central Wisconsin.**—*J. econ. Ent.* **50** no. 3 pp. 336–337, 2 refs. Menasha, Wis., 1957.

In further tests in 1952–54 on the control of insects attacking second-crop lucerne grown for seed in Wisconsin [*cf. R.A.E.*, A **45** 21], emulsion sprays were applied with a low-volume tractor sprayer at the pre-bloom stage. The average seed yield in the three seasons was significantly increased by sprays of 0·5 lb. DDT with 0·25 lb. aldrin, 0·125 lb. heptachlor or dieldrin, 0·5 lb. chlordane or 0·75 lb. toxaphene, or of 1 lb. methoxy-DDT (methoxychlor) or 0·5 lb. DDT alone per acre, but not by treatment with 0·25 lb. Systox [diethyl 2-(ethylthio)ethyl phosphorothioate (demeton)] or 0·25 lb. parathion, though there were no significant differences between treatments. DDT alone and in mixtures caused significant reductions in the population of the Mirids, *Adelphocoris lineolatus* (Goeze), *A. rapidus* (Say) and *Lygus lineolaris* (P. de B.), and of *Empoasca fabae* (Harris), against which methoxy-DDT was also effective, and all treatments but DDT alone and demeton controlled grasshoppers, including *Melanoplus bivittatus* (Say), *M. confusus* Scud. and *M. mexicanus* (Sauss.). On the whole, the DDT mixtures were the most satisfactory. Seed production was low in spite of good pest control, and lack of pollinating insects was thought responsible.

Metcalf (R. L.), Fukuto (T. R.) & March (R. B.). **Plant Metabolism of Dithio-Systox and Thimet.**—*J. econ. Ent.* **50** no. 3 pp. 338–345, 6 figs., 14 refs. Menasha, Wis., 1957.

The following is substantially the authors' summary of this account of investigations on the metabolism of O,O-diethyl S-2-(ethylthio)ethyl phosphorodithioate (dithio-Systox) and Thimet (O,O-diethyl S-ethylthiomethyl phosphorodithioate) in plants. When the bases of young cotton and lemon plants were treated with the two compounds synthesised from ^{32}P, they were absorbed and translocated at about equal rates, but only about 0·5–0·75 times as fast as demeton-S (O,O-diethyl S-2-(ethylthio)ethyl phosphorothioate) [*cf. R.A.E.*, A **44** 232], which was found to be much more soluble

in water. The processes of metabolism for the two compounds were primarily oxidative. After uptake of dithio-Systox by cotton, lemon, bean or lucerne plants, the compound was oxidised very rapidly to produce the sulphoxide, O,O-diethyl S-2-(ethylsulphinyl)ethyl phosphorodithioate, and more slowly to produce the corresponding sulphone, O,O-diethyl S-2-(ethylsulphonyl)ethyl phosphorodithioate [*cf.* **45** 181]. The sulphoxide and sulphone were also oxidised to produce O,O-diethyl S-2-(ethylsulphinyl)ethyl phosphorothioate and O,O-diethyl S-2-(ethylsulphonyl)ethyl phosphorothioate, respectively. Thus, at intervals of a few days to a month after application, all four oxidation products may be present in plant residues, but no dithio-Systox remains. Thimet behaved in an analogous manner, but showed different rates of metabolism. The sequence of consecutive reactions for dithio-Systox and Thimet in isolated cotton leaves was plotted, and preliminary investigations on their kinetics were made. All the simple oxidative metabolites of dithio-Systox and Thimet were prepared in the pure state, and their properties are recorded; the successive steps in oxidation increased the anti-cholinesterase activity of both compounds, as measured against fly-brain cholinesterase, the Thimet series being somewhat the more active of the two.

Typical harvest residues of the dithio-Systox metabolites were evaluated in experiments in which the radioactive compound was used as a direct spray on cotton plants 52 days before harvest and as a seed treatment for lucerne. The results indicated that the ultimate toxic residues are present in only fractional parts per million. The application of the knowledge of the metabolism of these compounds in plants to analytical studies by cholinesterase assay is briefly discussed.

Koehler (C. S.) & Gyrisco (G. G.). **The systemic Action of Lindane in Alfalfa upon the Meadow Spittlebug.**—*J. econ. Ent.* **50** no. 3 pp. 346–347, 8 refs. Menasha, Wis., 1957.

The following is based on the authors' summary. In laboratory experiments begun in 1954 in New York, under conditions that eliminated the possibility of fumigant or contact action, lucerne plants growing in soil treated with 20 ml. 0·25, 0·1 or 0·05 per cent. emulsified solution of lindane [almost pure γ BHC] per U.S. quart were found to remain toxic for at least six weeks to nymphs of *Philaenus leucophthalmus* (L.) transferred to the foliage. When part of the plant was sprayed with the insecticide and removed five days later, the untreated foliage remained toxic to test insects for 30 hours. The effect was considerably more powerful in plants growing in treated soil than in those sprayed with comparable concentrations, and it is concluded that it was due to systemic action [*cf. R.A.E.*, A **45** 362, etc.]. The results suggest that this may account in part for the high specificity of γ BHC to *Philaenus* nymphs and for the fact that the application of small volumes of γ BHC spray with weed sprayers, which often results in somewhat incomplete plant coverage, seldom fails to effect complete control of these insects.

Ely (R. E.), Moore (L. A.), Carter (R. H.) & App (B. A.). **Excretion of Endrin in the Milk of Cows fed Endrin-sprayed Alfalfa and technical Endrin.**—*J. econ. Ent.* **50** no. 3 pp. 348–349, 7 refs. Menasha, Wis., 1957.

The following is based on the authors' summary. Hay made from lucerne that had been sprayed with endrin at 2·7 and 6·6 oz. per acre in 1953 and 7·8 oz. per acre in 1954, harvested a week later and stored dry in bales for six months was found to contain 2·8, 3·7 and 1·9 parts per million of endrin,

respectively. Dairy cows that were fed with the hay for 48 days in 1953 and for 63 days in 1954 produced milk containing 0·15, 0·14 and less than 0·05 p.p.m. endrin, indicating that a daily intake of more than 20 mg. endrin (0·06 mg. per kg. body weight) as a residue on forage would be necessary for the appearance of measurable amounts in the milk. When the cows were fed with capsules containing endrin dissolved in soy-bean oil, a daily intake of more than 0·6 mg. per kg. was necessary for detection in the milk. Two cows that received more than 1·5 mg. endrin in soy-bean oil per kg. body weight showed toxic symptoms, but the milk from them contained only low concentrations of endrin (approximately 0·2–0·3 p.p.m.).

TASHIRO (H.). **Susceptibility of European Chafer and Japanese Beetle Larvae to different Strains of Milky Disease Organisms.**—*J. econ. Ent.* **50** no. 3 pp. 350–352, 4 refs. Menasha, Wis., 1957.

The following is substantially the author's summary. The comparative susceptibility of third-instar larvae of *Amphimallon majalis* (Razoum.) and *Popillia japonica* Newm. to strains of the milky-disease organisms, *Bacillus popilliae* and *B. lentimorbus*, was investigated in spore injection and ingestion tests at 70 and 80°F. *B. popilliae* was represented by the regular type A and the DeBryne strain [the latter obtained from a plot in Newark, New York, in which the bacillus had been established in 1945], and *B. lentimorbus* by the *Amphimallon* type B strain [*cf. R.A.E.*, A **43** 423]. The results showed that infection occurred more slowly by ingestion than by injection, but that the incidence of disease was about the same after three weeks. All three strains were more infective for *A. majalis* than for *P. japonica* by either method of inoculation. The DeBryne strain showed the greatest difference, *Amphimallon* being very susceptible to it and *Popillia* practically immune, and the difference was greater at 70 than at 80°F. After incubation for three weeks at 70°F., 90 per cent. of *Amphimallon* larvae became infected as a result of injection and 81 per cent. as a result of ingestion of spores, as compared with only 1 per cent. of the *Popillia* larvae.

The tests indicated that all three strains are promising for the control of *A. majalis*. The diseases have not proved very effective against it in the field in western New York, and this is probably due to low soil temperatures during the periods of active feeding in autumn and spring. In these circumstances, the DeBryne strain of *B. popilliae* promises to be the best.

VAN DEN BOSCH (R.). **The Spotted Alfalfa Aphid and its Parasites in the Mediterranean Region, Middle East, and East Africa.**—*J. econ. Ent.* **50** no. 3 pp. 352–356, 3 refs. Menasha, Wis., 1957.

In view of the recent spread of *Myzocallis* (*Therioaphis*) *maculata* (Buckt.) as a pest of lucerne in the United States [*cf. R.A.E.*, A **45** 11], a search for natural enemies of it that might be suitable for introduction was made between June 1955 and May 1956. The Aphid was found on lucerne in Cyprus, Israel, Italy, Yugoslavia, Turkey, the Lebanon, Persia, Iraq, Ethiopia and Eritrea, but not in Kenya, and on berseem (*Trifolium alexandrinum*) in Israel and Egypt. It was accompanied by *M.* (*T.*) *trifolii* (Monell) in Egypt and by *Aphis craccivora* Koch (*medicaginis*, auct.) in Italy. In addition, *M.* (*T.*) *ononidis* (Kalt.) was found on *Ononis* sp. in Italy, *M. trifolii* and *M.* (*T.*) *luteola* (Börn.) on clovers (*Trifolium* spp.) in Turkey, *M.* (*T.*) *riehmi* (Börn.) on sweet clover (*Melilotus*) and *M. trifolii* on *Trifolium* sp. in Persia, and *Macrosiphum pisum* (Harris) and *A. craccivora* on lucerne in Kenya. *Myzocallis maculata* appeared as a pest only in Israel [*cf.* **45** 14] and Turkey. The parasites of it found comprised two Braconids, *Praon*

palitans Mues. and *Trioxys utilis* Mues. [**45** 377], and *Aphelinus semiflavus* How., all in Israel, Italy, Turkey and Persia, *P. palitans* also in Yugoslavia and the Lebanon, and *T. utilis* also in Iraq. All three were forwarded to the United States and are being propagated in the laboratory in California.

Krueger (H. R.) & Casida (J. E.). **Toxicity of fifteen Organophosphorus Insecticides to several Insect Species and to Rats.**—*J. econ. Ent.* **50** no. 3 pp. 356–358, 5 refs. Menasha, Wis., 1957.

As most of the published data on the toxicity of organophosphorus insecticides to insects were obtained by differing methods and are therefore difficult to correlate, the authors carried out tests in which 15 compounds were applied topically in acetone to five species of insects reared under uniform laboratory conditions, in acetone solution to water to which larvae of a mosquito (*Aëdes aegypti* (L.)) were transferred and by subcutaneous injection to adult male white rats. The LD50's obtained are shown in a table. Of the insects treated topically, adults of *Macrosiphum pisum* (Harris) were generally the most susceptible to the 15 compounds, and adults of *Musca domestica* L. and *Blattella germanica* (L.) and larvae of *Laphygma* (*Prodenia*) *eridania* (Cram.) and *Attagenus megatoma* (F.) (*piceus* (Ol.)) progressively less so. Paraoxon was the most generally toxic of the compounds to insects, including the mosquito larvae, but it was also the most toxic to rats, whereas malathion, which approached it in toxicity to some of the insects, was the least toxic of all to the rats.

In view of its high toxicity, paraoxon was further tested by topical application to 22 species of insects, comprising Orthoptera, Hemiptera, Coleoptera, Lepidoptera, Diptera and Hymenoptera, collected in the field near Madison, Wisconsin, in the summer of 1955. In general, the LD50's, expressed as μg. per g. body weight, ranged from 0·3 for adults of *Oncopeltus fasciatus* (Dall.) and *Bombus* spp. to 4·5 for adults of *Epicauta pensylvanica* (Deg.), but they were extremely low (0·03 and 0·08) for the adults of *Crioceris asparagi* (L.) and *Acalymma vittata* (F.), though not for larvae of the former or adults of a related beetle.

Polivka (J. B.). **Effect of Chlordane on Broomsedge when applied to Turf for Control of Japanese Beetle Grubs.**—*J. econ. Ent.* **50** no. 3 p. 360. Menasha, Wis., 1957.

Plots of turf on a golf course in Ohio that were treated in 1950 with 1, 5, 10, 15, 20 or 25 lb. chlordane per acre, applied as a wettable powder in a constant quantity of dust diluent for control of the larvae of the Japanese beetle [*Popillia japonica* Newm.], showed no differences in stand of broomsedge (*Andropogon virginicus*) until October 1955, when those treated with the first five were estimated to contain only 75, 60, 40, 20 and 5 per cent. of the amount found on plots treated with the diluent only, and those receiving the last had none; similar differences in the grass stand persisted in October 1956.

Semel (M.). **Occurrence of Corn Borer in Potato Tubers.**—*J. econ. Ent.* **50** no. 3 pp. 360–361, 5 refs. Menasha, Wis., 1957.

Although potato is an important food-plant of *Pyrausta nubilalis* (Hb.) in the United States [*cf. R.A.E.*, A **28** 175], the tubers are not normally injured. The author records that, in Long Island in 1956, a large population

of second-generation larvae seeking more favourable environmental conditions after chemical destruction of the haulms attacked tubers that had been exposed by heavy falls of rain.

Fahey (J. E.) & Hamilton (D. W.). **Demeton Residues in Peaches.**—*J. econ. Ent.* **50** no. 3 p. 361. Menasha, Wis., 1957.

Since demeton [diethyl 2-(ethylthio)ethyl phosphorothioate] could possibly be used for the control of Aphids and mites on peach, the residues remaining in the fruits and their rate of degradation were investigated in 1956. Four trees were sprayed with 0·75 pint 26·2 per cent. demeton concentrate per 100 gals. on 14th June and 5th and 26th July, and residue analysis by inhibition of cholinesterase showed the presence of 2·94, 0·95, 0·75 and 0·18 parts per million demeton in whole peaches on 26th July and 1st, 8th and 15th August, respectively, the final figure being less than the official tolerance (0·75 p.p.m.) for apples and pears. The values were very slightly higher for fruits with the stones removed.

Smirnoff (W. A.). **An undescribed Species of *Lorryia* (Acarina, Tydeidae) causing Injury to *Citrus* Trees in Morocco.**—*J. econ. Ent.* **50** no. 3 pp. 361–362, 1 fig., 1 ref. Menasha, Wis., 1957.

Numerous colonies of an unidentified mite of the genus *Lorryia* were observed round females of *Saissetia oleae* (Bern.) on *Citrus* in two areas in Morocco in the autumn of 1955, apparently attracted by the honeydew excreted. Eggs were deposited in masses, sometimes in two or three layers, and hatched in 3–4 days, and the whole life-cycle was completed in 12–14 days. The mites spread to all the foliage and branches of a tree in a few weeks, and to the whole of a 250-acre orchard in some 3–5 months. Colonies were present on the lower surfaces of the leaves in the spring of 1956, but did not seem to feed on them. They appeared on the young fruits at the end of July, and were then injurious, all stages piercing the fruits and causing the formation of rings of dead tissue, which enlarged as the fruits developed. Dusting with sulphur in early spring or spraying with Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] when the fruits are ripening is recommended for control; the addition to the latter of 1·5–2·5 per cent. white oil for the control of *S. oleae* is suggested.

Wallis (R. L.), Smith (F. F.), Wheeler (H. G.) & Taylor (E. A.). **Malathion Residues on Vegetable, Berry, and Tobacco Crops.**—*J. econ. Ent.* **50** no. 3 pp. 362–363, 3 refs. Menasha, Wis., 1957.

Further experiments [*cf. R.A.E.*, A **42** 397; **44** 126] were carried out in Maryland in 1955–56 to determine the amounts of malathion deposited on the edible portions of vegetables classified as leafy (such as lettuce and parsley) and fleshy (such as carrots, cucurbits, okra [*Hibiscus esculentus*] and rhubarb), berries (blackberry and raspberry) and tobacco by sprays and dusts under field conditions and its subsequent deterioration. The insecticide was applied by hand equipment at 1·75 lb. per acre in dusts and wettable-powder or emulsion sprays, and samples were harvested within an hour or as soon as the sprays had dried and were analysed on the same day. If the residue was heavy, further samples were taken at intervals for up to a week or more.

The results, which are given in detail in a table, showed that residues were heavier and persisted longer on the leafy vegetables than on the fleshy ones

or the berries; similar quantities were deposited from the different formulations, but those from emulsion sprays were reduced faster than those from wettable-powder sprays or dusts. Rainfall reduced residues; the amounts after 14 days were 11–15 parts per million on parsley protected from it and 2–11 p.p.m. after exposure to 0·74 inch rain, and washing the parsley reduced the initial residue considerably. In most tests, the residues on leafy vegetables remained above 8 p.p.m. for three days or more if there was no rain, but those on fleshy vegetables were very low, even initially; only okra showed more than 8 p.p.m., and washing in tap water reduced this considerably. Residues on berries were moderately heavy, but fell below 8 p.p.m. within a day. Large amounts of malathion were deposited on tobacco leaves, and the subsequent reduction proceeded more slowly than on leafy vegetables; residues remained above 8 p.p.m. for five days, but were reduced by rainfall after eight days. There was an apparent increase in the amount deposited by treatments applied as the season progressed, applications on 7th August and 10th September resulting in residues of 13–17 and 33–53 p.p.m., respectively, and this was thought to be due to a reduction in the weight of the leaves with age. No malathion residues have been reported on cured tobacco.

Frings (H.), Frings (M.) & Little (F.). **Peanuts as Substitute Food for the Large Milkweed Bug.**—*J. econ. Ent.* **50** no. 3 pp. 363–364, 3 refs. Menasha, Wis., 1957.

The substitution of blanched groundnuts for the seeds of milkweed [*Asclepias*] in the laboratory rearing of *Oncopeltus fasciatus* (Dall.) [*cf. R.A.E.*, A **41** 91] has not always given satisfactory results, and the value of groundnuts as food for the bug was therefore investigated. Examples reared from the egg stage on blanched groundnuts developed more slowly and with greater variation in rate and poorer survival than those provided with milkweed seeds, and the adults produced only about 20–25 per cent. as many eggs. The groundnuts were apparently lacking in certain nutrient factors, and the addition of even small quantities of milkweed seeds to them permitted satisfactory growth and survival. Groundnuts are blanched by heat treatment to remove the seed-coats, and the fact that some batches completely failed to support the bugs suggests that the process destroys some nutrient factor. Raw groundnuts gave more uniform results, though the growth rate and survival were still low. With either groundnuts or *Asclepias*, survival was higher when the food was not changed than when it was changed, even at monthly intervals. When the bugs were reared on raw groundnuts through five generations, there was no improvement in growth rate or survival on this food and development was slower on *Asclepias* seeds than for examples from parents reared on these. It is concluded that groundnuts, though less satisfactory, can be used as a substitute for milkweed seeds, but that differences in blanching make it advisable to use raw rather than blanched ones.

Spencer (H.) & Selhime (A. G.). **Experiments with Kelthane for the Control of Citrus Red Mites.**—*J. econ. Ent.* **50** no. 3 pp. 364–365, 5 refs. Menasha, Wis., 1957.

In tests in Florida in 1955, acaricides for the control of *Panonychus* (*Metatetranychus*) *citri* (McG.) on orange were added to the post-bloom combined spray, consisting, unless otherwise stated, of 1 lb. each of 15 per cent. wettable parathion, 52 per cent. zinc oxide and manganese oxide, 1·5 lb. 53 per cent. basic copper sulphate and 5 lb. 90 per cent. wettable

sulphur per 100 U.S. gals. and applied between 20th April and 5th May. The results showed that the application of 1, 2 or 4 U.S. pints of an emulsion concentrate containing 20 per cent. Kelthane [1,1-bis(p-chlorophenyl)-2,2,2-trichloroethanol], 1, 2 or 4 lb. 25 per cent. wettable Kelthane, 0·66 lb. 25 per cent. wettable Aramite [2-chloroethyl 2-(p-tert.-butylphenoxy)-1-methylethyl sulphite] or 3 U.S. quarts 90 per cent. oil emulsion gave immediate control of the mite. Sulphur was omitted from the oil-emulsion spray, and manganese oxide was replaced by manganese sulphate with hydrated lime in those containing 1–2 lb. wettable Kelthane. The populations were low, but beginning to increase, on treated plots in June and much higher on all plots in late July, but significantly lower on trees receiving either Kelthane formulation at the two higher rates than on others. They were high by 13th September and showed a natural decline by 18th November, with no significant difference between plots on either date. Fruits picked on 5th December, when 29·15 ins. rain had fallen since spraying, showed 0–0·11 part Kelthane per million in surface extracts, 0–0·03 p.p.m. in pulp and 0·27–0·46 p.p.m. in the peel of those that had received the emulsion sprays, and still lower average residues on those treated with the wettable-powder sprays, so that there is no danger of harmful residues if the material is included in the regular post-bloom spray. None of the sprays damaged the trees.

Fahey (J. E.), Hamilton (D. W.) & Rusk (H. W.). **Effect of Spray Date on Residues of Chlorinated Hydrocarbon Insecticides on Peaches.**—*J. econ. Ent.* **50** no. 3 pp. 366–367, 3 refs. Menasha, Wis., 1957.

As *Cydia* (*Grapholitha*) *molesta* (Busck) and *Conotrachelus nenuphar* (Hbst.) attack peaches as late as July and August in southern Indiana and Illinois, an experiment was carried out in 1956, when rainfall was above normal, to determine the residues that would remain on the fruit after late applications of chlorinated insecticides. Sprays containing 2 lb. 50 per cent. DDT, 1 lb. 50 per cent. dieldrin or 25 per cent. heptachlor, 10 oz. 19·5 per cent. endrin or 3 lb. 40 per cent. chlordane per 100 U.S. gals., with various adjuvants, were applied six times between 27th April and 7th July, with one, two or three additional applications at 10-day intervals on some plots, and samples of peaches collected immediately after the last spray, at harvest (16th August) and halfway between were analysed for residues. At harvest, residues were 5·3 and 11·9 parts per million (official tolerance 7 p.p.m.) for DDT applied 40 and 30 days before, 0·8 p.p.m. (tolerance 0·3 p.p.m.) for chlordane applied 40 days before and 0·12 p.p.m. for heptachlor applied 20 days before. The results for dieldrin and endrin, which were obtained by total-chlorine analysis and were hence non-specific, indicated that applications within 30 days of harvest might result in residues of more than 0·1 p.p.m., the official tolerance for the former.

Ruckes jr. (H.). **The overwintering Habitat of the Sugar-pine Cone Beetle.**—*J. econ. Ent.* **50** no. 3 pp. 367–368, 3 refs. Menasha, Wis., 1957.

Twigs of sugar pine [*Pinus lambertiana*] mined by adults of *Conophthorus lambertianae* Hopk. [*cf. R.A.E.*, A **36** 301] were observed in several areas in California in May 1956. Newly mined twigs containing beetles burrowing in the tips were found in the Sierra Nevada Mountains in the first week of September; the beetles entered at the base of the vegetative bud and mined only the current year's growth, remaining in the twigs during the winter and early spring.

Knipling (E. B. [*i.e.* E. F.]) & Sullivan (W. N.). **Insect Mortality at Low Temperatures.**—*J. econ. Ent.* **50** no. 3 pp. 368–369, 2 refs. Menasha, Wis., 1957.

Much attention has been given to means of killing insects in aircraft to prevent the spread of injurious species from one part of the world to another. Jet-powered aircraft, however, have to fly at altitudes at which outside temperatures range from −42 to −65°C. (−43·6 to −85°F.), and it is possible that insects hiding in the unheated parts of these aircraft would be killed by the cold to which they would be exposed. This possibility was investigated by exposing nymphs and adults of *Periplaneta americana* (L.) and grasshoppers, larvae and adults of *Epilachna varivestis* Muls. and adults of *Popillia japonica* Newm., *Tribolium confusum* Duv., *Aëdes aegypti* (L.), *Musca domestica* L. and *Dermacentor variabilis* (Say) to various low temperatures for one hour and then allowing them a recovery period of 24 hours at 10–35°C. (50–95°F.). Complete kill of all the insects except *Tribolium* was obtained by exposure to −15°C. [5°F.] and below, and of *A. aegypti*, but not the others, by exposure to −10°C. [14°F.]. *Tribolium* and *Dermacentor* were exceptional in that a few examples of both survived at −20°C. [−4°F.], though none did so at −15°C. or −30°C. [−22°F.]. A further test indicated that exposure to −20°C. for 12 minutes was adequate for 100 per cent. kill of *A. aegypti*, while exposure for 15 and 30 minutes resulted in 99 and 100 per cent. kill of *M. domestica*.

Burkhardt (C. C.). **Carrot Beetle Control in domesticated Sunflowers.**—*J. econ. Ent.* **50** no. 3 p. 369, 1 ref. Menasha, Wis., 1957.

Adults of the Dynastid, *Ligyrus gibbosus* (Deg.), were extremely abundant in Riley County, Kansas, in mid-August 1956, and as many as 90 per plant were found on varieties of sunflower (*Helianthus annuus*), feeding on the roots and stalk bases and causing lodging and failure to produce seed. The application of 5 lb. heptachlor or 3 lb. dieldrin in 25 U.S. gals. emulsion spray per acre, directed towards the base of the stalks and on the ground for at least six inches on both sides of the row, or of 7·5 lb. heptachlor or 4·5 lb. dieldrin per acre in granules applied as a six-inch band down the row on 16th August, caused 97·3, 90·4, 93·7 and 88 per cent. mortality, respectively (as calculated by Abbott's formula [*R.A.E.*, A **13** 331]), by 18th August, when numerous dead beetles were found on the soil surface of treated rows.

Doucette (C. F.). **The Lily Bulb Thrips on Easter Lily.**—*J. econ. Ent.* **50** no. 3 pp. 369–370, 2 figs., 3 refs. Menasha, Wis., 1957.

Liothrips vanceckei Priesn. [*cf. R.A.E.*, A **20** 688] was found attacking bulbs of Easter lily (*Lilium longiflorum*) in a garden in western Washington in 1952 and in greenhouses there and in western Oregon in 1955 and 1956, when feeding on the tips of the young shoots as they grew out of the bulb distorted the early leaves. It was evident that very small numbers of the thrips on the bulbs could initiate a colony big enough to cause damage under greenhouse conditions, but early treatment with a parathion spray killed the thrips and rendered most of the plants saleable. In one greenhouse, adult thrips spread to plants in the small-bud stage, and reproduction and development took place in the bud clusters, giving rise to colonies of 15–20 individuals, which distorted the leaves and flowers by feeding on the buds and stems.

Ditman (L. P.) & Ditman (J. L.). **An Apparatus for measuring Corn Earworm Injury to Sweet Corn.**—*J. econ. Ent.* **50** no. 3 pp. 371–372, 1 fig., 1 ref. Menasha, Wis., 1957.

The authors describe the construction of a graduated triangular board that can be used to measure the extent of the injury caused to ears of sweet maize by the corn earworm [*Heliothis zea* (Boddie)]. When calibrated for a particular variety, it also shows the percentage loss of kernels. The method of using it is explained.

Kerr (T. W.). **Leafhoppers infesting Lawns in Rhode Island.**—*J. econ. Ent.* **50** no. 3 p. 372, 1 ref. Menasha, Wis., 1957.

Surveys of 15 representative lawns in Rhode Island were carried out between late May and late October 1956. Of a total of 35,576 Cicadellids collected by sweeping with a net, 44·7 per cent. were *Macrostelcs fascifrons* (Stål), 19·9 per cent. *Deltocephalus pulicaris* (Fall.), 13·5 per cent. *Endria inimica* (Say), and 4·7 per cent. *Graminella nigrifrons* (Forbes); 2 per cent. comprised seven other species, and the remainder were immature stages, mainly of the first four mentioned. *M. fascifrons* was particularly abundant where the grasses forming the lawns included *Lolium multiflorum*, and was slightly less numerous on *Poa pratensis* and *Festuca rubra commutata*; *Deltocephalus*, *Endria* and *Graminella* showed a preference for the latter, but the first two were also collected from *P. pratensis*, *Endria* from *Agrostis tenuis*, and *Graminella* from various other species. *M. fascifrons* was most numerous during early June, mid-July and late August, *D. pulicaris* in late June and late August, *E. inimica* in early July and early September and *G. nigrifrons* in late June, late August and early October.

A spray of 1·2 oz. DDT in 7·5 U.S. gals. water per 1,000 sq. ft. of turf afforded control of all species for about two months, and the same quantity of methoxy-DDT (methoxychlor) was as effective against *G. nigrifrons* and *D. pulicaris*, but controlled *M. fascifrons* and *E. inimica* for only half as long.

Oscinella frit (L.) was found in all the lawns throughout the collecting period; it was more numerous than all the Cicadellids together and especially common in late June and early July.

Vincent (L. E.) & Lindgren (D. L.). **Laboratory Evaluation of contact Insecticides on three Species of Stored-product Insects.**—*J. econ. Ent.* **50** no. 3 pp. 372–373, 3 refs. Menasha, Wis., 1957.

In the experiments described, 20 insecticides were dissolved in acetone and applied dorsally behind the head capsules of fourth-instar larvae of *Trogoderma granarium* Everts, larvae and adults of *Tribolium confusum* Duv. and adults of *Calandra* (*Sitophilus*) *granaria* (L.), after which the insects were kept with small amounts of food in petri dishes at 80°F. and 60 per cent. relative humidity and examined for mortality after 20, 10, 5 and 10 days, respectively. The resulting LD50 and LD95 values are shown in a table.

In general, pyrethrins and the organic phosphates, parathion, methyl-parathion, malathion, Am. Cyanamid 4124 [O,O-dimethyl O-2-chloro-4-nitrophenyl phosphorothioate] and Chlorthion [O,O-dimethyl O-3-chloro-4-nitrophenyl phosphorothioate], were the most toxic, and Phostex [a mixture of bis(dialkyloxyphosphinothioyl) disulphides], piperonyl butoxide, chlordane, methoxy-DDT (methoxychlor), DDD (TDE) and nicotine the least toxic to all the insects; DDT and Strobane [a chlorinated mixture of α-pinene isomers

with a chlorine content of about 66 per cent.] were ineffective against larvae of *T. confusum*, and these compounds and lindane [γ BHC], aldrin, dieldrin, heptachlor, toxaphene and allethrin against *Trogoderma* larvae.

When the LD95 was less than 25 μg. per insect and comparisons could be made, it was observed that *Trogoderma* larvae were more resistant than the other insects tested, except to Am. Cyanamid 4124, and that the larvae of *Tribolium* were more resistant than the adults.

Doutt (R. L.). **Biology of** *Solenotus begini* **(Ashmead).**—*J. econ. Ent.* **50** no. 3 pp. 373–374, 1 fig., 3 refs. Menasha, Wis., 1957.

The Eulophid, *Solenotus begini* (Ashm.), is an important parasite of Dipterous leaf-miners in California; its host range is known to include 19 species in five genera of Agromyzids, and it commonly attacks species of *Liriomyza* in commercially grown melon, vegetables and lucerne [*cf. R.A.E.*, A **40** 84]. Observations on its bionomics as a parasite of *Phytomyza atricornis* Mg. in the leaves of *Sonchus oleraceus* were made in the laboratory at 78°F. and 65 per cent. relative humidity, with material obtained from Albany, California. Reproduction is arrhenotokous. The fertilised or unfertilised female readily detected the host mine while crawling over the leaf and followed it until it found the host larva, which it stung with its ovipositor before depositing a single egg in the mine, a few millimetres away from the larva. The latter continued to feed meanwhile, but died in about 25 minutes. The parasite larva hatched within 24 hours, moved along the mine to the host and fed on it externally for three days. It then moved away for 1–2 cm., spent one day as a prepupa and pupated, the pupal stage lasting six days; the manner of pupation is described. The emerging adult left the mine through a circular hole cut in the wall with its mandibles.

Brunson (M. H.). **Notes on Parasites of Oriental Fruit Moth Cocoons.**—*J. econ. Ent.* **50** no. 3 p. 374. Menasha, Wis., 1957.

Three unusual parasites were observed attacking *Cydia* (*Grapholitha*) *molesta* (Busck) in cocoons exposed in successive samples for seven days on the trunks and branches of peach trees between 25th May and 15th August 1956 in New Jersey. Total parasitism averaged 18 per cent., and *Eupelmus limneriae* How., which had been found only twice in several thousands of cocoons examined in 1931–45, represented 5 per cent. of 478 parasites reared. *E. cyaniceps cyaniceps* Ashm., which had not been reared from this host before in New Jersey, was obtained from two cocoons, and *Tritneptis hemerocampae* Gir. from one.

Howe (R. W.) & Lindgren (D. L.). **How much can the Khapra Beetle spread in the U.S.A. ?**—*J. econ. Ent.* **50** no. 3 pp. 374–375, 1 map. Menasha, Wis., 1957.

The senior author has developed a method of predicting the potential distribution and economic importance of insects attacking stored products from laboratory observations. The developmental period, sex ratio, oviposition rate and mortality at different stages are found under constant conditions appropriate to the environment to be considered and are used to calculate a theoretical rate of increase, from which the local importance of the species can be judged. Since *Trogoderma granarium* Everts does not develop at temperatures below about 70°F., it is considered likely to become important in the United States, where it has recently spread considerably, only where

the average temperature exceeds 68° F. for at least four months of the year, and as, furthermore, it does not compete successfully with *Calandra* (*Sitophilus*) *oryzae* (L.) or *Rhizopertha dominica* (F.) at relative humidities above about 50 per cent., its rapid multiplication over a wide area is likely only in California, Arizona and Texas [*cf. R.A.E.*, A **45** 259], though it could increase considerably in certain areas in Nevada, New Mexico, Oklahoma and Kansas.

Predictions of the distribution of stored-product insects on a climatic basis break down when storage environments are independent of external temperature, particularly where buildings are artificially heated, and surveys for *T. granarium* should therefore be maintained, in heated premises and commodities liable to heating, in the north and east of the United States. Thermocouples for detecting heating in grain and corrugated paper to serve as traps for wandering larvae are useful tools, but small populations are difficult to detect, especially at ports.

Schneider (F.). **Some Insect Pests of Pistachio in Syria.**—*FAO Plant Prot. Bull.* **6** no. 5 pp. 65–71, 8 figs., 9 refs. Rome, 1958.

In Syria, pistachio (*Pistacia vera*) is cultivated round Aleppo and to some extent near Damascus and is attacked by several insect pests. Where the trees grow under adverse soil conditions hindering the formation of tap roots, *Capnodis cariosa* (Pall.) causes severe damage, and the dying trees provide a favourable medium for the breeding of *Hylesinus* (*Chaetophorus*) *vestitus* (Muls. & Rey). Both these beetles are widely distributed. *Capnodis* destroys many trees each year east of Aleppo. The larvae of this Buprestid bore in the roots, causing the trees to die, and are difficult to control. Withered trees should be uprooted in spring or summer and infested roots burned. A spray of DDT or dieldrin applied 2–3 times to the leaves in summer, at times when the adults are numerous, would probably reduce the number of eggs laid. Little or no damage is caused to trees growing in deep soil. *Hylesinus* breeds in dying or dead trees and has one generation a year. The adults of this Scolytid emerge at the end of spring from the trees in which they have developed and bore short galleries into the terminal or floral buds of healthy trees, in which they rest during summer and winter. At the end of winter, they return to dying trees or branches and excavate galleries, in which the eggs are laid. A loss of 30 per cent. of the buds on healthy trees is common, new growth is reduced, and small branches break easily. The intensity of the attack varies with the distance from breeding sites and with direction, the beetles preferring to fly against the prevailing north-west wind, but the presence of a single infested dead tree in an orchard usually results in heavy losses. The population can be reduced by leaving a few dying trees during autumn and winter to attract the ovipositing adults and burning them or removing the bark when the larvae have hatched.

On old gnarled trees north-east of Damascus, *Pachypasa otus* (Dru.) and a Gelechiid described by P. Weber in 1957 as *Schneidereria pistaciella*, gen. et sp. n. [*Mitt. schweiz. ent. Ges.* **30** pt. 1 pp. 68–72] are injurious. The eggs of *Pachypasa* are laid in bark fissures or stem cavities in September, and the larvae hatch in the same year, feed on the leaves, overwinter in deep stem cavities, and feed again on young leaves in spring. Feeding occurs at night, and the larvae shelter in stem cavities by day, where they can be destroyed by hand-picking, though an insecticide would probably give more rapid results. *S. pistaciella* may prove to be a synonym of *Recurvaria pistaciicola* Danil., which infests pistachio in the Soviet Union and Persia [*cf. R.A.E.*, A **45** 424]. The larvae enter the half-ripe nuts, in which they destroy the kernels; by mid-September, all had left the nuts and bored into

old torn bark on the upper part of the stem, where they overwintered in groups in cocoons. There is apparently only one generation a year. For control, old bark should be removed and burned during winter. Sprays applied to the fruits after the main oviposition period or to the stems before the larvae leave the nuts would probably reduce the infestation.

Bailey (S. W.). **The Position of Khapra Beetle in Australia.**—*FAO Plant Prot. Bull.* **6** no. 5 pp. 72–73, 5 refs. Rome, 1958.

In view of unconfirmed reports of the establishment of *Trogoderma granarium* Everts in Australia, the author points out that such records have been based on the discovery of beetles, usually in small numbers, in cargoes of grain exported from Australia by ship and examined on arrival at foreign ports. In such instances, the grain was probably infested during the voyage by beetles originating from previous cargoes. The only reliable record of *T. granarium* in Australia is a single occurrence in a cargo of barley received in Tasmania from South Australia, and shipping was again involved. A survey of cereals in all the mainland States and groundnuts in Queensland revealed no trace of infestation, and the beetle is unknown there to those engaged in the industries concerned.

Martyn (E. J.). **The Distribution in Tasmania of *Aphodius howitti* Hope, and *A. pseudotasmaniae* Given, in Relation to Climate.**—*Tasm. J. Agric.* **27** no. 4 pp. 391–404, 10 figs., 14 refs. Hobart, 1956.

Pests of pastures in Tasmania studied in work begun in 1948 included *Aphodius howitti* Hope and *A. pseudotasmaniae* Given [*cf. R.A.E.*, A **39** 408, 410; **40** 161; **45** 451], of which the larvae feed on the leaves of grasses in improved pastures on light soil. The thinning that results permits increased penetration of the sward by frost, which causes direct damage and also retards growth in spring. Some invasion by weeds also occurs, but more important is an increase in the clover component, which may become dominant. In addition, some loss of pasture is caused by the covering of the lower parts of the plants by soil excavated during the construction of the larval tunnels. Heavy winter rains check infestation [*cf.* **31** 264], but immersion for three days was necessary to cause any appreciable mortality among larvae of *A. pseudotasmaniae* in the laboratory, so that the effect is mostly attributable to exposure of larvae washed out of their burrows to predators and unfavourable conditions, general debility following immersion and increased susceptibility to fungus attack.

The effect of climate on the distribution of the two species was investigated, and the following is based on the author's summary of the results. *A. pseudotasmaniae* is of general occurrence in Tasmania and is the commoner except in the north-western coastal strip. *A. howitti* occurs in the north-west, north and north-east, but the only record from the south is of a single specimen reared from larvae collected at Gretna. It is the only species recorded from King and Flinders Islands, in Bass Strait. From a consideration of the mean summer and winter temperatures and average annual and winter rainfall, it is concluded that rainfall has at most a minor effect on distribution. *A. howitti* is limited to areas where mean summer and winter temperatures reach at least 59 and 44°F., respectively, becomes dominant where winter temperatures reach 48°F., and completely replaces *A. pseudotasmaniae* where they reach 51°F. It also occurs in favoured micro-environments within areas with air temperatures below the limiting ones. *A. pseudotasmaniae* occurs in areas with mean winter temperatures of up to 48°F. and is favoured where they do not reach 45°F. It is suggested that

A. howitti has not yet occupied all the areas suitable for it, and that its range is likely to increase with further pastoral development.

Brimblecombe (A. R.). **The Pine Bark Anobiid.**—*Qd agric. J.* **83** no. 11 pp. 637–639, 4 figs. Brisbane, 1957.

Ernobius mollis (L.) is recorded for the first time infesting locally grown timber in Queensland, where it has been intercepted in imported wood several times in recent years. Brief notes are given on its bionomics and control, and the adults and larvae are briefly described. It is restricted to dead pine wood with the bark attached, and removal of the bark from logs and sawn timber affords protection.

Howe (R. W.). **Studies on Beetles of the Family Ptinidae. 14. The Biology of *Ptinus pusillus* Sturm.**—*Ent. mon. Mag.* **92** no. 1108 pp. 331–333, 14 refs. London, 1956.

In this part of a series dealing with Ptinids associated with stored products [*cf. R.A.E.*, A **46** 64], the results are given of laboratory investigations on the development of *Ptinus pusillus* Sturm, which is found only in Europe and has in recent years been recorded fairly frequently in England. The work was carried out with a stock reared on wheatfeed from adults collected in a London wharf and supplemented by others collected in a pigeon's nest. In general, development was most rapid at about 25°C. [77°F.], and its duration and the weight of the newly emerged adults both varied inversely with the rearing temperature. *P. pusillus* resembled some other Ptinids in passing through a resting stage [*cf.* **40** 68], which occurs in the full-grown larvae or newly emerged adults in the cocoons and largely determines the duration of development. At 20°C. [68°F.], males completed their development in about a year when there was no adult resting stage; at higher temperatures, development occupied about six and seven months for males and females, respectively, and at 17·5°C. [63·5°F.], 14 and 15 months. The resting stage probably ensures emergence during late summer under the variable conditions experienced in warehouses in Europe. As in the other diapausing species, there is one generation a year at most, and the adults usually emerge in autumn and survive until the following midsummer.

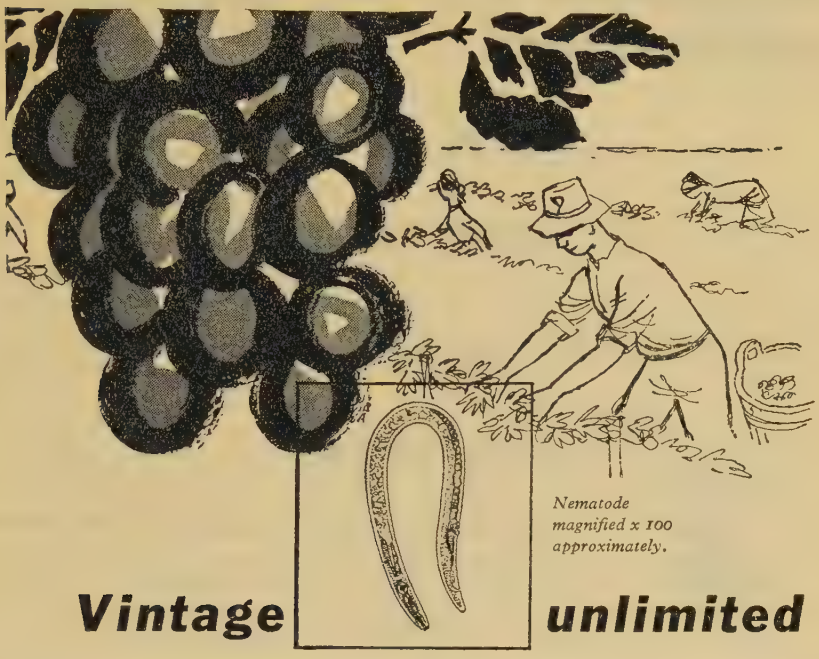
Distribution Maps of Insect Pests.—Series A, nos. 85–90. London, Commonw. Inst. Ent., 1958.

These maps are nos. 85–90 of a series already noticed [*R.A.E.*, A **40** 203; **45** 504] and deal, respectively, with *Lepidosaphes ulmi* (L.), *Macrosiphum solani* (Kalt.), *Aphis pomi* Deg., *Anastrepha fraterculus* (Wied.), *A. ludens* (Lw.) and *A. mombinpraeoptans* Sein.

Papers noticed by Title only.

Gardner (J. C. M.). **An annotated List of East African Forest Insects.**—*For. tech. Note E. Afr. Agric. For. Res. Org.* no. 7, 48 pp., 6 refs. [Kikuyu, 1957.]

Roivainen (S.). **On the Distribution of *Ceuthorrhynchus* Species (Col., Curculionidae) occurring as Pests of cruciferous Plants in Finland. I.** *Ceuthorrhynchus assimilis* **(Payk.),** *C. quadridens* **(Panz.) and** *C. rapae* **(Gyll.).**—*Ann. ent. fenn.* **23** no. 2 pp. 111–114, 3 maps, 4 refs. Helsinki, 1957.



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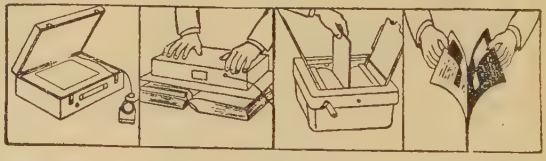

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